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Marxism Today

EDITORIAL COMMENTS

J.-P. VIGIER — RATIONALITY AND MODERN SCIENCE

SCIENCE SUB-COMMITTEE OF THE COMMUNIST PARTY — THE FUTURE FOR FUNDAMENTAL RESEARCH IN GREAT BRITAIN

BOB WILLIAMSON — THE GENETIC CODE

DISCUSSION:

JAMES HARVEY — THE NATURE OF THE STATE

JACK DUNMAN, N. M. SEEDO — NO ROOM FOR HOMO SAPIENS?

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Marxism Today

Vol. 10 No. 12

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Editorial Comments

THE TIMES Supplement on "Britain on her way to Europe" (October 28th, 1966) provided an interesting sample of opinions on the consequences if Britain entered. Even strong supporters of the Market admitted that Britain would have to go through "a time of troubles" in the process of getting into it. Thus Mr. John Whitehorn, Deputy Director General of the Confederation of British Industries agrees that if Britain did *not* go into the Common Market:

> "We should avoid cost and price increases of some magnitude and the added burdens to our balance of payments."

Mr. Whitehorn further admits with regard to entry into the Market:

> "It is difficult to see how this period of massive changes could contribute to an immediate improvement in the balance of payments. For besides the factors outlined above, the Common Market agricultural policy might present us with a bill for contributing to the European Agricultural and Guidance Fund of anything between £200 million and £350 million and this would be a direct burden on the balance of payments."

What would Britain's position be with regard to flights of capital and movements against the pound generally. Says Mr. Whitehorn:

> "There is no reason to fear a substantial outflow of capital [from Britain] but it would be essential for the Government to maintain a climate in the country attractive to investors. The conclusion is clearly that we should not contemplate entry until the balance of payments has been put on the right road—an objective which is of course of crucial importance for us in any case."
>
> ". . . There will be some short-term difficulties, but they will I believe, be outweighed by the long-term gains of membership of the community."

Sir George Bolton, a director of many banks, is equally emphatic on the short term difficulties:

> "In the short term, however, it seemed probable that the trade balance would be adverse to Britain in that competition would be immediate, whereas the reorganisation of British industry will take some years. Pressure on sterling would probably increase in the early stages of short term membership, thereby exacerbating the problem of our substantial short-term debt. In this context it is obvious that, as domestic inflation has weakened sterling to the extent that strongest credit and exchange restraints are and will continue to be necessary, *British industry will not be in any position to finance any extended reorganisation.* (Italics ours.)

Mr. Fritz Berg, President of the Federation of German Industry, has small consolation for British agriculture:

> "In the last analysis I am unable to imagine how a solution could be attained without a basic change in British agricultural policy. Certainly an increase in the domestic price level connected with a change-over would generate major problems, but these should not be over-rated. Our efforts must aim at keeping such burdens within bearable limits."

So the slogan of the marketeers evidently is "Forward to the Common Market, to increasing 'short term difficulties', to a rise in the British price level, but bear with it. In the long run things will be all right."

Collective Bargaining

When is the Government going to restore the right of collective bargaining taken from the unions by the squeeze and freeze of last July? There are some Labour M.P.s whose answer is "never". Thus Mr. Raphael Tuck, Labour member for Watford, told the House of Commons in the Prices and Incomes debate on October 25th that "The idea of collective bargaining was all right in 19th century economics when there was a free for all but it is not right today. *In my view there should be collective planning and not collective bargaining.*"

It is evident that some Labour M.P.'s consider that the future role of the trade unions consists in doing what the Government tells them to do and liking it. Mr. Stewart told the House during the same debate that after the total freeze, there would be a period of severe restraint, in which only a few selected groups of workers would get any increases, and then after that "when there are claims by anyone for increased incomes—workers for wages, or landlords for rents—it must be recognised that the bargaining power of the two parties is not the only thing that matters; that the public interest is there as third party".

But who embodies the public interest? Some bureaucrat from the Ministry of Labour? Frank Cousins told Stewart "It is no good saying 'There is now a third party sitting in your discussions'. One has to define it. It is the Government. The Government are to sit in. I ask myself, in what role? Are they sitting, as they sat in the Colonial Territories,

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as arbiters between employers and employees? Are they there to tell them what the economy can stand and to make sure there will be no strike action if there is no agreement? Is this the kind of thing we envisage or do we envisage something more elaborate?"

There was no answer. All that Mr. Crossman could say in winding up was that the Government had ten months to find a solution to the problem which baffled the Attlee Government and then the Tory Governments for thirteen years.

It is high time that the Trades Union Congress stopped wasting time looking for a pseudo-solution. The way forward is for the unions to table their wage demands and demand immediate negotiations. The way to restore collective bargaining is not to wait for the Government, the Trades Union Congress and the Confederation of British Industries to square the circle. It is to table wage demands and back them up by trade union action. The way to restore collective bargaining is to exercise it.

Those Taxes Again

One of the most widely developed dogmas amongst the rich is that Britain is the most heavily taxed country in the world. That this is *not* so, the following figures from the Organisation of Economic Co-operation and Development (published in *Hansard*, October 25th) show. Here is the percentage of the Gross National Product raised by taxation in various European countries in the year 1965:

> United Kingdom 34.6 per cent; Belgium 33.4; Italy (1964) 35.8; Netherlands 37.6; West Germany 39.6; and France 45.8 per cent.

The percentage of the Gross National Product represented by social security contributions is as follows:

> United Kingdom 5.4 per cent; USA 4.8; Belgium 9.7; Italy 13; Netherlands 12.4; West Germany 11.3; France 16.8 per cent.

So do not be over-impressed the next time you read of some tycoon wailing about overtaxed Britain.

World-Wide Protests Against U.S. War in Vietnam

President Johnson's recent tour of Australasia and South-East Asia has been a further indication of the world-wide anger against United States aggression in Vietnam. In New Zealand, the President had to be separated from the people by a barrier of barbed wire.

During his visits to Canberra, Melbourne and Sydney, Johnson met determined mass demonstrations involving what the correspondent of America's National Broadcasting Corporation called the "most concentrated hostility of his career".

The political managers of the tour were on the defensive from the beginning to the end.

In Canberra, Johnson dodged hostile demonstrators for hours and then ignominiously sneaked in the kitchen door of the hotel.

In Melbourne, the official procession dodged a planned demonstration by 2,000 students and then ran the gauntlet of a 3,000-strong crowd opposing the Vietnam war policy.

In Sydney, four separate major demonstrations of from 1,000 to 10,000 people took place in four hours at points separated over a distance of five miles, throwing the official party into near panic.

In Manila itself, police fought for hours against the thousands of people demonstrating against the U.S. president; batons and tear-gas were used against the demonstrators. In Singapore and Malaysia, hundreds of left-wing supporters were arrested even before Johnson arrived; and on the day of his arrival, demonstrations were held in Kuala Lumpur, Penang, Ipoh, Malacca and Johore Bahru, as well as in Singapore. In Kuala Lumpur police fired on the demonstrators, killing at least one and wounding seven.

The U.S. President never included Japan in his tour. In taking this decision, he was following in the footsteps of General Eisenhower, who, at the time he was U.S. President, cancelled his trip to Japan after his Press Secretary had been mobbed by thousands of hostile demonstrators at Tokyo airport. There is no doubt that had Johnson visited Japan he would have run into a wall of hatred, so intense is the feeling of the Japanese people against the barbarous war being waged by the U.S. against Vietnam.

Expression of this feeling was given on October 21st, when, at the call of their official trade union congress, named Sohyo, a million workers came out on a protest strike against the war. *This is the first large-scale political strike against the war yet to take place in a major capitalist country.* A report on the strike now available states that despite the Government's warning that it would be illegal, 54 trade unions took part, including miners, railway workers, transport workers, dockers and teachers. The strike began at midnight, when the miners decided to hold scores of short meetings, photo exhibitions and leaflet distributions instead of going to work. The 280,000-strong railwaymen's union held two-hour strikes throughout the country. Dockers on strike in Yokohama distributed leaflets to the crews of foreign ships urging them to stop carrying freight

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for the American army in Vietnam. Teachers in primary and secondary schools, as well as in seven state colleges, came out in a nation-wide action alongside the industrial workers. By their spirited action the Japanese people and trade unions have given a splendid example to working people throughout the capitalist world.

Mau Mau from Within

It is asserted by British officials that the armed struggle of the Kenya people in the 1950s, which was given the name of "Mau Mau", was a savage attempt to massacre the white settlers. Official figures themselves give the lie to this claim—11,000 Africans killed by Government forces, and 90,000 detained, as against 30 Europeans killed along with 2,000 African Home Guard and others siding with the Government.

The real character of this historic struggle is described and analysed in a new work, *Mau Mau from Within* (MacGibbon & Kee, 63s.). Presented by Professor Donald Barnett, with a long introduction and explanatory prefaces to each chapter, this is basically an autobiography of Karari Njama, a Kikuyu schoolteacher, who took to the forests after the 1952 declaration of a State of Emergency in Kenya. Njama himself, though his writing is modest, clearly played a leading part in the struggle, acting as political adviser to one of the forest leaders, Stanley Mathenge, then as secretary and adviser to Dedan Kimathi, who became Prime Minister of the Kenya Parliament, the elected leading body of the forest fighters.

No-one who seriously wishes to understand the period of the Emergency in Kenya can ignore this unique and valuable book. Here, for the first time, is a detailed and vivid analysis of the actions of the 20,000 Kikuyu, Embu and Meru people who fled to the mountain forests in 1952 and 1953 to escape government repression. Here they brought together their scattered groups of armed men to establish the Land and Freedom Army and its leadership, the Kenya Defence Council. This Council, in 1954, was superseded by the Kenya Parliament which was intended to act as an interim African Government of Kenya.

Though faced with intense difficulties, having to ensure regular supplies of food, manufacture their own weapons, and establish methods of organisation and administration, these forest fighters showed great resourcefulness and initiative. Records were maintained, food storage and distribution organised, and hospitals established. At first it must have appeared to the fighters in the forest that they could defeat the armed forces sent against them by the British. But as the months went by, and especially after the guerillas were cut off from the peasants in the reserves, who were herded behind barbed-wire in police guarded settlements, and from the workers in Nairobi who had hitherto provided the men in the forests with recruits and supplies, the difficulties mounted.

Harrassed by the enemy, desperate for food, torn by internal dissension and personal ambition, the fighters saw their forces dwindling and breaking up. By 1956 the main effort had been made. Dedan Kimathi was captured and hanged. The revolt grinded to a close. But it had struck a blow for freedom not only for Kenya where the Emergency was officially ended in 1960 as the national leaders met in London to negotiate independence, but for the whole of British-held Africa. Without the lesson of the "Mau Mau" revolt, still more effort would have been required to compel British imperialism to retreat in Ghana, and Nigeria, as well as in east and central Africa.

Thus "Mau Mau" was historically justified. Yet the cause for which these 20,000 men (and women) fought and died is not yet fully won. Independence has been gained, but most of the fighters and hundreds of ordinary people are still without land and without work.

In helping to break the conspiracy of silence about the struggle of the Land and Freedom Army, this book also makes a measure of retribution to the humble men and women who were the true heroes of the years of forest fighting.

The Dialogue Continues

It is just over ten years since the death of the French Jesuit priest-scientist Teilhard de Chardin. His death removed the Church's ban on his writings, which have exercised a deep influence in the Catholic world, but not amongst Catholics alone.

When the first conference of the Pierre Teilhard de Chardin Association of Great Britain and Ireland met in October, one of the most intently heard lectures was given by the French Marxist Roger Garaudy, and one of the central themes of the whole conference was that of dialogue and understanding between Christians and Marxists.

Through his many writings on science and on theology and in his more intimate letters and journals, Father Teilhard constantly affirmed that Christians must study and accept the findings of science, that the world and history have a meaning, that man has a future on this earth, and that he must actively work to make that future a reality. These were beliefs that afford a strong basis for understanding between his followers and Marxists.

For Garaudy the dialogue between Catholics and Marxists seemed almost a question of survival:

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> "The International Communist Movement after the 20th Congress of the Communist Party of the USSR in 1954 and the Catholic Church after the second Vatican Council have entered into the œcumenical age by beginning the fight against dogmatism. There is no more urgent or more vital task today, for a Christian as for a Marxist, than to carry that fight to its conclusion. That is the deep meaning of our dialogue: between two confronting dogmatisms, equally assured of possessing a complete and finite verity about the meaning of life and of the world, no dialogue is possible, but only a crusade between two fanaticisms. And a crusade in the present state of the techniques of destruction means the annihilation of mankind. The human epic commenced two million years ago would thus, in coming to an end, lose all its significance. Dialogue, in our days, is an essential condition if life and the world are to have a meaning."

The Rev. Anthony Dyson, a Minister of the Church of England, Chaplain of Ripon Hall, Oxford, brought a moving lecture to an end with these words:

> "Marxism and Christianity are both, in their founding charters, revolutionary movements committed to action. . . . To pursue entirely separate ways is for Marxism and Christianity a mutual impoverishment. . . . For a task of such dimensions [as the future of man] involves all the resources of all men."

It was perhaps an unaccustomed sight to see an audience of 700 or so, with a considerable proportion of priests and nuns, warmly applauding the appeals made for mutual Christian-Marxist understanding. No voice was raised against this. It would seem that Christians and Marxists with very different approaches to questions of religion, can find a common faith in the future of man, and begin to work out common tasks to make that future a reality.

Catholics and the Left

There is growing in Britain, particularly amongst young people, a left-wing Catholic trend, which considers that Christians, to be consistent and true to their faith, must be socialists, or more than that, militant, radical, indeed Marxist socialists.

A little over two years ago a group of Cambridge undergraduates, with the help of some priests, decided to launch a periodical committed to a radical examination of the Roman Catholic Church. They called it *Slant*, and we have written of it before in these columns.

Since then it has been put on a national footing and the Catholic publishers—Sheed and Ward—have recently published the "Slant Manifesto" under the title of "Catholics and the Left" (Sheed and Ward, *Stagbooks*, 13s. 6d.), and in the form of a series of essays.

The introduction of the Manifesto explains *Slant's* fundamental approaches:

> "Roughly speaking, the periodical and the group which supports it, is engaged in the exploration of the idea that Christian commitment at the moment carries with it an obligation to be socialist."

Four years before the emergence of *Slant*, another group—professors, workers, and some priests—started an annual conference, and, from its period of meeting, became known as the December group. Now the two groups have merged.

A number of influences contributed to the developing approaches of the *Slant* group—F. R. Leavis, for example, Wittgenstein, Raymond Williams, The New Left, but above all their thinking has been influenced by the work of Marx, and when they write of the need for socialism they do not mean the traditional reformism of the Labour Party leadership, which they strongly criticise, but the militant, revolutionary, Marxist socialism.

As Adrian Cunningham and Terry Eagleton write in the Manifesto, the group has reached the "incredible conclusion":

> "that Christians can never be Conservatives or liberals or even right-wing socialists; they must fight capitalism as evil; they must align themselves . . . with all the traditional enemies of the Church, left-wing socialists and atheistic Marxists."

The writers of the *Slant* Manifesto see the universe, earth, society, and Christianity, all in the process of development. If men are to change, then society must change, or rather be changed:

> "My personal reality, as an individual, is in a real way the property of my society, a commonly shared reality. My sense of identity is derived from society; I came into being as a man, within society's terms. To be fully a man is to be fully in community with others."

And when they examine what sort of a community, what sort of society can end man's alienation, and permit the fullest development of each individual, they turn to Marx and his conceptions of socialism and communism.

The *Slant* group want to contribute to a "radical reworking of Christian theology in terms of the living political, cultural and philosophical traditions of our society and time", and consider that such a radical approach to theology demands the acceptance of the political ideas of the militant (radical is the word they use) left:

> "It is only in . . . radical socialist terms that Christianity is any longer intelligible and meaningful, let alone realisable."

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Certainly there are many problems, political and philosophical, that Communists would wish to discuss with the *Slant* group—problems of the state (which seem somewhat neglected), for example, or their view on liberalism, or problems of what commitment to militant socialism means in terms of daily practical politics, political action and political organisation.

But with their general approaches we feel both a warm sympathy and a deep intellectual interest.

German Edition of Marx and Engels

We wrote last month that the Soviet Institute of Marxism-Leninism had completed its 39-volume edition of the works of Marx and Engels.

Meanwhile the Institute of Marxism-Leninism of the German Democratic Republic has been working since 1956 on the most comprehensive German edition to date of the Marx-Engels works.

The first 26 volumes (completed all but the latter part of the *Theories of Surplus Value*) contain all the main works. Vols. 27-39 (of which vols. 27-33 are now available) will contain the Marx-Engels correspondence. And supplementary volumes are under preparation containing in detail the early works (1837-44).

The Dietz Verlag which has so admirably published this edition has now made available a most valuable book for students—*The Marx-Engels Index* (*Marx-Engels Verzeichnis*), based on volumes 1-26.

The index lists all the writings of Marx and Engels arranged chronologically according to the dates of composition. Supplementary indices provide lists of the titles in their original languages, lists of all works published in different books and pamphlets which contain material by other authors, and lists of all articles published in periodicals.

As soon as the Marx-Engels correspondence has been completed a further index will be published, and, in due course, a full index to the *contents* of the Marx-Engels works as well as a bibliography of all the various editions.

The Maurice Thorez Institute

After the death of Maurice Thorez, the French Communist Party decided to found, in his memory and in order to strengthen the fight for which he always stood—a Maurice Thorez Institute.

Many thousands of people subscribed to the building of the Institute[1] which contains a library, archives and meeting halls, and the essential aim of which is to become "a centre for the study of Marxist thought and of the working-class movement, an Institute of the social sciences". It is open to people of different outlooks, people experienced in study and research and experienced in struggle, ranging from erudite academicians to workers from the factories. By now the Institute will have held its first conference on "the People's Front in 1936".

Two issues have already appeared of the Institute's Journal[2] which is devoted to the history of the French Communist Party, of the international socialist movement, of the trade unions, the Resistance and the evolution of socialist thought.

Particularly timely (in the first issue) are the documents on the conditions that gave rise in France of the early 1930s to working-class unity and then to the People's Front. Amongst these is Thorez's powerful call for unity at the July 14th meeting of leaders of the Communist and Socialist Parties. It was following this meeting that the National Council of the Socialist Party registered a majority of 3,471 to 366 (with 17 abstentions) for a resolution accepting the Communits proposal for united action.

One of the most valuable features of the Journal (and this to be a permament feature) is the publication of memories, recollections of veterans of the movement including Lucien Midol on some of the great strikes of 1919-20 and Professor Marcel Cohen on the Dreyfus Affair and on the student movement of the 1890s.

A New Sputnik

January next will see the publication of the first issue of *Sputnik*,[3] a monthly magazine which, using first-class printing and photographic reproduction, will present a broad picture of Soviet life and literature in English translation of articles and stories from a number of well-known Russian periodicals—*Yunost* (Youth), *Literaturnaya Gazeta* (Literary Newspaper), *Molodoi Kommunist* (Young Communist), *Nedelya* (the Week), *Krokodil*, *Ogonyok*, *Novy Mir* (New World), *Nauka i Zhizn* (Science and Life), to quote a few.

For students of the Russian language, there will be an easily-removed section in each issue; also, for those who would like to check enjoyably on their progress in the language, there will be a Russian-language edition (*on subscription only*, at the same rates as the English Edition).

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[1] At 64 Boulevard Auguste Blanqui, Paris 13e.

[2] *Cahiers de l'Institut Maurice Thorez*—No. 1, April 1966 and No. 2, July-September 1966.

[3] Originally announced and advertised as *Russian Digest*. Each issue will be over 200 pages at 2s. 6d. per copy. Subscriptions 20s. for one year or reduced rate of 32s. for two years. Orders and enquiries to Central Books Ltd., 37 Gray's Inn Road, London, W.C.1, who can supply advance sample copies.

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Rationality and Modern Science

Jean-Pierre Vigier[1]

As we said at the beginning of this discussion, classical rationalism at the beginning of the 19th century was based on the tremendous progress of the physical and mathematical sciences. This period is truly one of the richest and most brilliant in all the history of human thought.

Classical Rationalism

Think of Newton, Laplace, Kant and many others: the great dream of understanding and mastering the world was becoming reality—the reign of the physicists was beginning. An apparently irresistible movement was drawing the scientific world towards a conception of a knowledge which could sum up the whole of the natural world. Caveing[2] has already singled out three essentially philosophical aspects of this movement. The first aspect is the hypothesis that science has a linear development, that it constitutes an accumulative system of knowledge, capable of explaining the totality of reality, so that in theory it is impossible for any zone of obscurity to persist.

The second aspect is that this rationalist scientific explanation of the world is founded on a mechanical determinism expressed in mathematical terms by Newton, Kant and Laplace. It is based on the inexorable chain of cause and effect; the world is conceived as an immense machine, governed by a finite system of laws entirely apprehensible to human reason.

The third aspect is the totalising nature of scientific knowledge. Such a conception implies the final disappearance of all forms of knowledge or methods of thought not directly based on scientific practice. Thus, as science undergoes a continuous and irresistible progress, the ensemble of phenomena can be completely reduced to a final analysis of its ultimate constituents—the atoms—whose behaviour is completely established once and for all by the master science—the mechanics of Newton and Laplace.

Such is the prodigious system which still impregnates all currents of modern thought. It seems to me that today's discussion should base itself essentially on the examination and criticism of these three aspects. To what extent are they valid today? To what extent should they be broadened or modified? Before we begin, I should like to remind you of some historical facts.

Rationalist System Challenged

During the 19th century, the rationalist system, the system of mechanical materialism, was subjected to two fundamental challenges. The first was that of the irrationalists, of the idealists. The adversaries of rationalism based their arguments on the failure of the classical physicists to explain the nature of life and thought. Think of the work of a philosopher such as Bergson, for example, who in the second half of the 19th century systematically opposed what he termed the characteristics of life to the properties of matter.

This idealist refutation was succeeded at the beginning of the 20th century by the empirio-critical criticism of science. Mach and his followers, having reduced science to a system of practical formulae, denied therefore the existence, or the possibility of existence of any knowledge not directly attainable by experience.

The second challenge was that of Marxist criticism. Marxism had undertaken the criticism of mechanical materialism by trying to enrich this conception through two essential contributions: namely the idea of a dialectic of nature, and the conception that the laws of classical logic were insufficient: that dialectical reasoning should be substituted for classical reasoning—a concep-

[1] Jean-Pierre Vigier is one of the most distinguished theoretical physicists now working in France. He is noted as being one of the small band of workers who have criticised effectively Bohr's theory of complementarity, which states essentially that the events occurring in quantum physics cannot be described in any way as caused events. His explanations have not been to the liking of many physicists, even in the Soviet Union, but they represent a serious attempt to find physical explanations to resolve a great philosophical difficulty, which has been and is still being used to introduce an element of mysticism into physical processes. The controversy still continues, and may find quite a different way of resolution. The article is translated from "Les Cahiers Rationalistes", of February 1966, the monthly review of the Rationalist Union.

[2] In a preceding article in the Symposium printed in the same issue of *Les Cahiers*.

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tion which constitutes moreover one of the driving forces of modern thought.

In the face of the empirio-critical attack against Rationalism—in the face of the refutation of science itself, Lenin counter-attacked by trying to surmount the difficulties of classical rationalism. He attempted first of all to widen its logic by using as his essential weapon the conception of the infinity of the properties and dimensions of matter. In other words, he contested one of the essential postulates of Laplace and Newton—the idea of the finite structure of matter: the idea that it was possible to explain the physical world on the basis of its atomic structure alone. In short he contested the conception of the finite nature of the system of laws governing nature.

To my mind, any attempt to re-define the bases of contemporary materialism and rationalism must take its genesis in Lenin's criticism, above all from the idea of the infinite complexity of matter linked to the new conception of its level of organisation.

In the first place, if nature is infinitely complex, if for example, new properties appear in high energy physics when one penetrates decreasing levels of dimension; when one passes, let us say, from the dimension of classical mechanics—the millimetre—to intervals of dimension of ten to the power of minus eight centimetres, new mechanics are discovered with each step in the direction of the infinitely small. Mechanics, like all science, has developed as we said earlier, by successive earthquakes which brought the preceding theoretical edifices crashing to the ground. The edifice of classical mechanics was destroyed by the revolution of Einstein. The idea of relativity, the idea of the unification of time and space: the idea of identifying the laws of nature with the properties of matter itself, has transformed the very concept of natural law, just as the revolution of quantum physics, the work of Planck, Schrödlinger, of De Broglie, etc., transformed our conception of the elements of matter.

Determinism and Causality

From this over-sketchy analysis we see that scientific practice over the last century has demonstrated that on the theoretical level scientific knowledge is not a cumulative knowledge. On the other hand, if matter is inexhaustible (as modern scientific knowledge would seem to indicate), if there exists an infinity of levels, no single level of scientific knowledge can hope to cover the whole of reality. In fact, the progress of our vision of the world resembles that of a system periodically overthrown by revolutions succeeding each other with ever-increasing rapidity.

Secondly, it seems to me that we must drop the classical conception of determinism, and causality, for two essential reasons.

The first reason is that if nature is infinite and organised in levels, no system whatever of determinist laws can possibly constitute a complete and closed system covering all or part of physical reality. For example: causal laws on one level—the laws of classical physics for example, cover statistical laws relative to the chance behaviour of matter on a deeper level: that is to say, on the level of the laws and the theory of the quanta. The very fact of the limitless nature of matter implies a dialectic of determinism and chance which can never be fully assimilated one into the other since the infinity of the elements of interaction in nature in theory introduce chance elements into every causal law. Vice versa, on deeper levels, statistical laws can themselves be analysed in terms of action.

The second reason is that the idea of the level of organisation—and no longer merely that of dimension—has introduced the concept of movements or collective properties qualitatively differentiated from the properties of the constituent elements.

This enables us to endow matter with an entirely new type of causality—a causality which to my mind constitutes one of the essentially new steps of scientific knowledge in our time. This new type of causality is not only the possibility of transmission of properties, as Laplace thought, by what I shall term a "causal chain"—that is to say, a sort of linear succession (a cause A engendering a consequence B which engenders a second consequence C and so on), but the possibility of transmitting a simultaneous initial causal ensemble. It is possible for example to make an ulterior order in time correspond to simultaneous elements. The transmission of this order constitutes the transmission of information in cybernetic terms.

It is this new property, this complexification of the notion of determinism, which constitutes the theoretical basis of the revolution of a man whom I consider on the scientific level as the Descartes of our time; the American physicist and mathematician Norbert Wiener.

A moment's thought shows that the simultaneous order of things, linked (as is well known) to the notion of entropy implies the existence of an essential new property, that of "retroaction" or "feedback". Indeed, the explosion of this notion into biology has dashed to the ground the work of Bergson, has swept away the arbitrary barriers erected by idealism of the so-called incapability of science of understanding the nature of life and thought.

I have no time to develop these two essential facts. I should like simply to state that a debate which

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has lasted 2,000 years between the philosophers of idealism and the philosophers of materialism; between those who contested the power of reason and those who affirmed it, has now been settled, not by philosophers, but by scientists in the most advanced laboratories of the world.

Today we know that the living cell, the fundamental basis of life—is nothing more than a physico-chemical machine. Life is a "recollection" formed by a macro-molecule of DNA, capable of reproducing itself. We also know that the brain is nothing more than a physico-chemical machine (although we do not claim at the moment to understand the totality of its behaviour) capable of producing inter-correlated pulses linked to external phenomena by a relaying of information—a machine whose constituent elements form what one may term a cybernetic brain capable of programming itself.

Science and Philosophy

Thirdly, it seems to me that the links between science and philosophy—links which constitute the essential philosophical problem of our epoch—should now be stated in entirely new terms.

I should like merely to advance certain ideas relating to this problem. The first is that there is no autonomous philosophical knowledge. The revolution in modern science clearly signifies to the immense majority of scientists the death of classical philosophy, the death of all metaphysics.

Precisely because there can no longer be any autonomous philosophical advance, the body of dogmatic philosophical thought turns against science and engenders new theologies. We Marxists experienced this in the Lysenko affair. In its essence, the philosophical attitudes of Stalin were a foreign body incompatible with the materialism of Marx and Lenin.

The second idea is that the discontinuous progress of science by successive revolutions no longer engenders one single body of materialist thought but a vague undefined series of successive materialist philosophies. In the last thirty years no single vision of the world built on the conceptions of physics, for example, has lasted more than a decade. Today, all the classical ideas on matter, on space and time, on the relations between law and object, have to be reconsidered.

We are carried away by a movement whose end we cannot see, for the simple reason that there is probably no end. A physicist's view of the world is radically changed several times in his own lifetime.

The third idea is that the links between philosophy and science must needs take on a qualitatively new aspect. If one conceives and defines philosophy as a unifying vision of the world, it is evident that this philosophy must be in direct and constant organic interaction with the movement of science, and of knowledge itself.

We said earlier, and I entirely concur, that such an edifice can no longer be erected by one man alone but by teams working together. It must result from the free confrontation of contradictory theories; confrontations which reflect precisely the antagonistic and contradictory movement of ideas which mutually dispute the claim to true knowledge, and of new conceptions which arise at every moment to put the preceding edifice once more into question.

Modern philosophy comes in at the frontier sectors, and must carry on a perpetual search for new elements of rupture.

The fourth idea, as I said before, is that the old problems of philosophy are now decided in the laboratory, or at least posed by scientists in completely new terms. Thus science becomes the battlefield of philosophical struggle—the contrary theories reflecting the struggle between different conceptions of the world.

Today science and philosophy stand in a new relationship to each other—a relationship which can be compared to the links between scientific theory and practice. The barriers between the disciplines have been swept away by the progress of knowledge—knowledge becomes more and more all-embracing. The wider it becomes, the stronger appear the contradictory elements within the body of knowledge which will engender its change.

The Period in which we Live

In conclusion, I should like to say a few words on the extraordinary nature of the intellectual period in which we live. It has been said time and time again, but has never been fully realised, that the explosion of science and philosophy in our own time is without precedent in the whole of human history. What is the ideological upheaval of the Renaissance compared to the revolution of an Einstein, or the revolution of quantum physics? What are the voyages of Magellan compared to the exploration of the solar system? What are the social changes of the Renaissance besides the great tidal waves of contemporary politics? Or the Reformation compared to the building of Socialism and the liberation of the colonial world. But parallel with this, formidable challenges have been thrown down by modern science to the very existence of man. The atomic bomb carries within it the destruction of humanity. Even more deeply, the scientific and technical revolution will of necessity transform the relations between man and man, and man and society.

Descartes said that "Of all the passions, intellectual enthusiasm was his chief passion"—he was right: the static systems of the past are today replaced by the formidable dynamic of science in full development. (*Translated by Judith Cohen.*)

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The Future for Fundamental Research in Britain

This article is the result of discussions and consultations with many scientific research workers carried out by the Science Sub-Committee of the Communist Party. We would thank all those, too numerous to mention by name, who participated. It is published in Marxism Today *to facilitate further discussion of the problems raised and the views expressed as to their solution and we would welcome views from readers.*

SECTION 1. THE NEW SITUATION

URGENT questions concerning the future of fundamental research in Great Britain have arisen in the last eighteen months. There is much talk of cuts, economies and general restraint of expenditure. At the universities, research workers complain of many shortages—of money, buildings, libraries, technicians. The final outcome of present discussions will profoundly affect individual research workers and the well-being of the country's future economy. It is therefore important to understand and analyse the present position, and to assess the correct way forward.

There are four main aspects requiring consideration. First, we have a new Governmental organisation for the administration of science, from the Committees of which new policies for fundamental research are emerging. Is this apparatus of Government appropriate for its job? Would a different form of organisation produce more realistic policies?

Second, there is the crisis caused by the Government's refusal to provide the money required to permit fundamental research to advance at the same rate as it has done over the last ten years. Is this a necessary or wise policy? Thirdly, and partly stimulated by the lack of money, are tentative efforts to analyse the internal structure and growth characteristics of fundamental research with a view to formulating policies for the future development of this type of research. Fourthly, there are problems concerned with the internal structure of research departments in universities and elsewhere—the lack of democracy is one important aspect—which directly and immediately affect the younger research workers, and about which little has been said by official bodies.

We shall review briefly the present position on the first three aspects, and then attempt a critical assessment of what policy should be on all of these four approaches.

The New Organisation of Scientific Research

The Department of Education and Science (D.E.S.) now supervises the five research councils—agricultural, medical, natural environment (which covers oceanography, hydrology, earth sciences and ecology), social science, and the science research council (which covers all fields of fundamental science except those which are within the defined responsibilities of the other councils). The University Grants Committee now reports to the same Department instead of as previously to the Treasury. There is also a Council for Scientific Policy which advises the Secretary of State for Education and Science on policy connected with all scientific research.

The Ministry of Technology is now responsible for some ten research establishments which were previously within the Department of Scientific and Industrial Research (D.S.I.R.)—such as the National Physical Laboratory, Building Research Station and the National Engineering Laboratory. The same Ministry is also responsible for the Atomic Energy Authority, the National Research and Development Corporation, the British Standards Institution and the group of industrial research associations. An Advisory Council on Technology guides the Minister.

One or two other Ministries have their own research institute (e.g., Road Research is now with the Ministry of Transport). There is a Committee on Manpower Resources for Science and Technology which reports jointly to the D.E.S. and the Ministry of Technology. And in an overall co-ordinating role for science and technology is Sir Solly Zuckerman, Chief Scientific Adviser to the Government, with the rank of Permanent Secretary.

The above is the field of civil research. Military research is organised quite separately under the Minister of Defence.

It will be seen that the responsibilities of the D.E.S. and the Ministry of Technology mean that both have a large interest in fundamental research, though the D.E.S. has the larger interest. We shall note that in fact the Council on Scientific Policy of the D.E.S. is apparently becoming the mouthpiece for theories on the development of fundamental science.

The way in which liaison is envisaged between the

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two Ministries mainly concerned with civil science has been clearly stated by Mr. Wilson, the Prime Minister: "The two Ministers in fact primarily concerned with science and technology will regard themselves as partners in a joint enterprise helped by the fact of interlocking membership of the Advisory Committee serving the two Departments."[1]

The Crisis of Finance

The predecessor of the new Council for Scientific Policy was the Advisory Council on Scientific Policy (A.C.S.P.) which issued its last Annual Report in December, 1964 (Cmnd. 2538). Concern was expressed then at the need to balance the financial requirements of "big science" (high energy nuclear physics and space research) against the many smaller demands from other fields of research. An estimate was made, covering the next five years, "based on the best information we have been able to obtain from scientists, from the Research Councils, and from the University Grants Committee, of the likely cost of supporting the overall demands of research wherever a purely scientific case, comparable to that made for high energy physics can be sustained". (D.S.I.R. stations and the Atomic Energy Authority were left out of this limited survey.) The Report went on to state:

> "We conclude that the sum required annually for the field of scientific research defined as above, would be £145 million in 1969-70, compared with £77 million in 1964-65. This includes the cost to the U.K. of the European programme . . ."
>
> "Expenditure on this scale would enable our scientists fully to deploy their ability and provide the essential background to our technological effort in industry as well as producing the trained manpower which industry requires. The Council does not claim that it would stop emigration of scientists but it would certainly remove lack of opportunity and of reasonable facilities from the list of reasons for it."

These proposals in fact envisaged that the rate of increase in research in these fields should continue until at least 1969-70 at about 15 per cent per annum, a rate which had been followed roughly for many years. The sum of £145 million in 1969-70 would have been only 0.6 per cent of the gross national product as at 1964. (All expenditure in the U.K., Government and otherwise, on scientific and technological research and development amounted in 1961-62 to 2.7 per cent of the gross national product.)

A public and official reply to this request, which showed that the Government were intent immediately to cut back on this proposed rate of increase, was given by Lord Bowden (then Minister of State for Education and Science) who said:

> "This year our scientists asked for very much more money than we had to give them . . . Expenditure on pure research has been doubling every five years. I know very few people who expect that we shall be able to double our present rate of expenditure more than three times in the foreseeable future . . . It is impossible indefinitely to encourage science to grow at a rate 5 or 6 times as great as the rate of growth of the G.N.P."[2]

He also argued for an immediate slowing down, stating that he envisaged a possible four-fold increase by 1985 (instead of by 1975 on present trends and on the requests of the A.C.S.P.).

The Report on Science Policy

That this financial stringency is continuing is shown in the Report on Science Policy published by the Council for Scientific Policy in May 1966 (Cmnd. 3007). The Report says (para. 9):

> "It has been represented to us that the capacity of the national economy will not permit the growth of Research Council expenditure at present rate (about 13% annually in real terms or a doubling every six years) within the limits of planned national expenditures . . . The question at issue is when, and at what rate, and on what criteria, the levelling-off of the growth rate should take place."

The Report discusses hard financial figures only for the year 1966-67 and says that for this year the level agreed represents a rise of 12.2 per cent in real terms. But the main bulk of the Report is devoted to the need, against the background of financial stringency, to attempt the development of criteria for scientific growth and to plan forward "in order to avoid catastrophic perturbations in the growth process later" (para. 10).

The need to consider planning is unarguable. It is significant that the last Report of the A.C.S.P. stated:

> "We know of no way to determine precisely what proportion of any country's gross national product should be devoted to the advancement and exploitation of science. Our own view is that the United Kingdom is still spending too little. But, if the resources which the Government can set aside for science cannot be increased sufficiently to allow us to embark on all the good scientific projects of which we know . . . the problem of priorities in science and technology lies at the heart of national science policy, and therefore of our national destiny" (para. 14).

[1] The Prime Minister addressing the Parliamentary and Scientific Committee on February 18th, 1965.

[2] Two articles and letter in the *New Scientist* based on a speech delivered by Lord Bowden at the opening of a seminar of the European Institute of Business Administration at Fontainebleau in September, 1965 (N.S. Vol. 27. No. 463, 30.9.65; Vol. 28. No. 464, 7.10.65; and N.S. of 11.11.65).

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But the approach of the new Council for Scientific Policy to this problem appears negative and restrictive and needs close examination. The idea of positive central encouragement for certain scientific fields is early eliminated by the statement that it is a misconception to imagine that the advance of scientific knowledge itself can be directed from the centre because of its unpredictability (para. 7). The tasks of science policy are seen to be: "to maintain the environment necessary for scientific discovery; to ensure the provision of a sufficient share of the total national resources; to ensure that there is a balance between fields and that others are not avoidably neglected; to provide opportunities for interfertilisation between fields, and between the scientific programmes of nations".

The Report suggests that the main components of growth of scientific research are:

i. the advancement of scientific knowledge and techniques;
ii. the expansion of the educational system (including research done by those engaged in teaching and research done for training purposes);
iii. international scientific commitments;
iv. national objectives involving "mission-oriented" research (e.g., many fields within agricultural and medical research).

A number of studies have been started to reveal the mechanics of growth, as follows:

a. the relationship with the educational system;
b. the parameters imposed by the availability of highly qualified manpower;
c. the measurement of increased cost due to the growing complexity of techniques and the more refined instrumentation and technical support needed ("sophistication");
d. measures to improve the scientific environment (computer resources and the educational use of Government scientific establishments);
e. the functioning of international scientific relations and commitments.

Such is present official thinking. A word must be said about the attitude shown to the cost of research before we come to a critique of the general strategy.

The Returns from Research

It is wrong and dangerous for the future of the economy to consider the *gross* amounts spent on research as being wholly expenditure. Research as a whole produces knowledge which eventually increases the wealth of the nation; a neglect of research in modern times will almost certainly guarantee poverty in the future. Some research may eventually fail; other sections may be giving good promise of tremendous returns; over the whole field of research effort, based on study of past experience, the average returns in increased wealth to the community should be measurable. It is vitally necessary, therefore, to think in terms of the *net* expenditure on research, and to analyse this both over the whole field and for certain specific fields of special promise. A much more elaborate system of scientific accountancy is necessary to ascertain the true cost (or value) of research. Such a system may show that, far from research being expensive, its returns are so great that we cannot yet afford to curtail its growth on purely gross financial grounds. The proportion of the gross national product involved is still sufficiently minute to allow policy to be formulated on long-term economic grounds and there is no need for stringency based purely on immediate financial considerations. We should be warned against any hasty curtailment by the fact that no other scientifically advanced nation, not even the United States, is at present faced with a curtailment of its rate of expansion of fundamental research.

SECTION 2. A STRATEGY FOR FUNDAMENTAL RESEARCH

How far are the plans of the Council for Scientific Policy adequate for the future guidance and support of fundamental research? An answer to this must start with some consideration of the nature of "fundamental" research.

What is "Fundamental" Research?

When one considers the research work carried on in our universities and by the research councils, it is clear that fundamental research has two possible motivations. One is to advance knowledge—so-called "pure" research—without any *specific* human need in view. Research into the structure of the atomic nucleus and the nature of the forces that hold it together, or research into the structure of the haemoglobin molecule are of this type. Such research arises from the internal logical development of a subject. Its social justification is that it makes more complete and extends the body of scientific knowledge which provides the starting point for all future research, development, industrial or social application—and it allows man to understand his status in the universe more fully.

The second motivation is the solving of some human or social problem. Thus work on "interferon" has the major motive of control of virus diseases; similarly the study of beams and particles is linked with metal cutting. Such research is often referred to as "applied" or "mission oriented" but the techniques and wide-ranging nature of the work are similar to those of "pure" research. (There is of course also short-term applied research—"trouble shooting"—and development work—but here the approach and width of work is very different.)

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So the fields of fundamental research are not only linked with the science subjects but with social and economic needs; and may be connected with so-called "technology" subjects and objectives as well as with the "pure" sciences. Any consideration of the future development of fundamental research must take account of these various aspects.

In the long-term all types of successful fundamental research are "useful". We should not endorse the opinions of those who pride themselves on the "uselessness" of their investigations and thereby show themselves ignorant of the social consequences of scientific discovery. Nor should we support the ideas of those who see the sole justification of their work in their individual satisfaction in doing it, and the gratification of their individual curiosity. Provided that they are reliable, there are no useless scientific discoveries, although some may be more significant than others. It is important that those who do research work find individual satisfaction in it, but this by itself cannot justify its expense.

Why must we do Fundamental Research?

In the first place, for the reasons that we do all research. The end is knowledge of nature and control over it, economic advance and development of living conditions in all senses.

The case for gaining technical knowledge is more obvious, particularly when there are restrictions on the free spread of information whether for motives of industrial advantage or military secrecy.

But unlike technical developments, the results of *most* pure research work throughout the world are freely published, and relatively freely available. Do we really need to do fundamental research with no immediate technical application? In a Britain drained of resources by overseas military expenses, the idea might appeal of living on the developments of science in other countries, and economising in our own expenditure on research. Deliberately or not, we are already following such a policy. And it can be disastrous.

Besides contributing to the international store of knowledge, people engaged in research themselves become trained in research techniques, and in the particular field of knowledge, by the very process of engaging in the work. Without fundamental research, a country comes to lack knowledgeable personnel. It is necessary to *use* scientific techniques in order to master, fully, the knowledge that they give; reading the journals can help, but cannot be a substitute.

For these reasons, fundamental research is needed to obtain balanced scientific development in any country: and a major reason for considering it essential is its function in the development of trained scientific personnel.

It is common experience, in this and other countries, that fruitful fundamental research can be done in the universities. There is good reason for this. The teaching background provides one of the best situations in which to extend scientific knowledge, because of the wide range of knowledge involved in teaching at degree level.

In turn, an awareness of current developments in a subject, which can only be obtained in full by participating in research, helps to keep the teaching work of the university up to date. This is essential with the present rate of advance, and it applies to universities with a technological bias as much as to the universities with a more traditional range of subjects.

But much fundamental research, both of the "pure" and "mission-oriented" type is done in the research establishments of the research councils and in research institutions coming under the Ministry of Technology.

In establishments devoted primarily to "mission-oriented" research, whether in engineering, chemical work, telecommunications, or building techniques, there is a need to set aside a proportion of resources to follow up phenomena of wider significance which emerge in the course of "mission-oriented" work.

The Co-operative Nature of Scientific Research Work

We do not see a future for British science simply in increased emphasis on isolated individual research. Indeed the organisation of research is already handicapped by the attitude that it is an individual, rather private, activity. Instead the reality is that research is very much a co-operative activity.

In the organisation of science we find a source of difficulties in the prevalence of the "prima donna" theory of scientific advance, which sees progress largely as the contribution of a few "great minds". In fact the bulk of scientific advance is the co-operative, cumulative effort of thousands of individuals. Proper tribute must be paid to the achievements of leading individuals, but what they contribute to scientific advance would be achieved, perhaps more slowly, in their absence. The outstanding individuals contribute significantly more than the average, and their greatest value can be in leading the work of a group of scientists.

It follows from the co-operative nature of scientific advance that much greater effort is needed to organise contact and communication between research workers in the same or allied fields. This is primarily a question of the finance needed for the arrangement of small informal discussion meetings, and visits of workers from one institution to another. Many research workers also encounter difficulties in

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attending conferences; this false economy needs to be discarded.

But more serious consequences of excessive individualism affect the organisation of research itself. In the past, funds have often been allocated to individuals rather than to teams; so that the departure from one department of a leading individual, via the "brain drain" to the U.S.A., or to a more attractive chair elsewhere, taking perhaps one or two leading individuals from the same group, leads to diminished support for that school of research in the original institution.

The need is to build up good research teams. It should not be dependent on "research emperors" moving about the country with their retinues. The days are gone when individual brilliant scientists could make stupendous changes in the economy; reliance in the future must be upon teams of experts.

In a smaller way, within any university department, it is important that equipment purchased should be available to the whole staff of the department, with at most a priority for the group receiving the grant.

The siting of those non-university research institutes which carry out fundamental research close to the universities themselves would give the possibility of increased efficiency in both teaching and research. It is quite absurd that in so many instances research institutes are sited miles away from universities lessening the opportunities for discussion and collaboration between staffs of both organisations. And the siting of departments within a university often shows a lack of forethought for the necessity of research co-operation. This need is given clearer recognition in the United States where, for example, university scientists are given encouragement to attend conferences and where the necessary money is liberally available.

Medical and Social Sciences

In medical science, the need is for an all-round expansion of research—both applied and pure where the distinction has any meaning. The research carried out in association with the teaching hospitals, and medical schools, is valuable, but in extent inadequate. The pace of discovery needs to be increased, by bringing the centres of practice—local hospitals—into action as centres of research as well to a much greater extent than at present. This will require action with the Ministry of Health and the Regional Hospital Boards.

It is a shortcoming of current medical practice in Britain that there is such a divorce between it and medical research. The solution is wider contact with, and participation in, research. Just as research in the universities raises the level of teaching, so widespread medical research in local hospitals can raise the level of medical practice.

But, as in all research institutions, consultation for research workers and respect for them—in short, democracy—is essential to good work. At present, all too often, the non-medical scientists are relegated to lower status; the automatic control by consultants over research units needs to be ended.

The social sciences have been in many ways the "cinderella" of the system. It is to be hoped that the establishment of the new Social Science Research Council (S.S.R.C.) will lead speedily both to the better co-ordination of social science research and to an all-round increase in the funds available for research of this kind.

But social organisations which would use the results—from town planning to housing policy, from psychology to prison policy and the law, are close to the basic motivation of social organisation—at present, the system of private profit. In the social sciences, above all, it becomes clear that a simple campaign for more funds will only touch the fringe of problems; it will be necessary also to call for more deep seated changes.

It is essential that the work of the Social Science Research Council shall be viewed in relation to the work of the other Research Councils and an integration achieved between the social and natural sciences. The need for this is two-fold: in several fields of fundamental research, the problems contain both natural and social aspects, and only an integrated approach by co-operative activity can produce realistic answers; secondly, the consideration of the development of science itself, the laws of its growth and so on, are essentially social science problems. It is a serious omission, therefore, that the Council for Scientific Policy as at present constituted, and concerned as it is with the development of science, has neither any individual social scientist or any representative from the S.S.R.C. among its membership.

Some Problems of Finance

Mention has already been made of the crisis in the financing of fundamental research. The problem of finance was often a major one to the research worker even before this crisis; now it will be increased.

The present means of obtaining research grants amounts to private enterprise in its worst form. At the same time, the use of the "begging bowl" to obtain money wastes the time of research men and women.

Funds may be collected piecemeal, from various industrial sources, from the Science Research Council (or the D.S.I.R. in the past), from other Councils, or from the U.G.C., so that foraging for funds becomes a major research activity. Success

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in research work is often linked with success in obtaining financial support. Particular criticism must be made of the policy by which the D.S.I.R. financed the starting of pieces of work, and then handed over responsibility for their subsequent maintenance to other sources.

The D.S.I.R. has now become the S.R.C. But the most favourable description of their policy is that they will look benevolently on requests that come in. This cannot be described as positive planning.

Within the universities shortage of money is only a part of the problem. Of course scientific research is always limited by the available resources, and could always make use of still more. Much greater resources would be available nationally were it not for military expenditure. But it is a minority of scientific workers who raise that complaint. A dissatisfaction much more commonly voiced is the erratic distribution of the existing flow of money.

In one university department it is possible to find funds quite adequate for current research projects. In another department, financial difficulties may be the major complaint, particularly with younger scientists. So much hinges on the attitude of the head of department who may, in one place, be active in obtaining funds for the whole department, and in another may be inactive and retain most of the available funds for his own direction. The solution lies in, firstly, greater democracy in the running of university departments and all research centres, and secondly in direct availability of the source of funds. That is, it must be possible to have direct access to the national research councils, or comparable bodies, without the support of the department head.

Without these measures, the "freedom" of scientific research will remain illusory for the majority of university scientists, for whom the "free choice" of subject may leave the work with little apparatus, little funds, and no assistance, so that progress becomes negligible.

The need for more democracy in our universities is dealt with again in the section on "Human Resources".

The Planning of Fundamental Research

To any suggestion of planning, some will express "concern" which is really obstruction of any alteration of the status quo. But besides this, many people may feel a genuine concern as to how far planning of research is compatible with a relatively free choice of research topic for the individual worker.

Fundamental research, for its success, often relies heavily on the interest, initiative, and insight of the individual. The most satisfactory work can be done by scientists who find the field of work acceptable, to the point of either choosing it in the first place, or choosing to remain in it after other considerations, such as job availability, have led them to it initially.

But the freedom of anyone is to choose between the alternatives available. The compatibility of freedom and planning can be achieved in this, as in other fields, by the steady improvement and expansion of the possibilities among which the individual may make his choice.

Because fundamental research involves the advancement of scientific knowledge at its very frontiers, its detailed planning and guidance in any subject can only be done by those engaged in it. As much as any other field, it is essential to have an extensive measure of industrial democracy. And at present the position in Britain is very unsatisfactory.

At the same time, once the necessary funds have been secured nationally for scientific research, including fundamental work, some arrangements have to be made for its distribution to different institutions and research workers. This may be done in an openly planned way, or as at present it may come to be done in an erratic way, which leaves many fields of work inadequately supported, and where such plans as there are do not receive open discussion.

The problem of planning Britain's scientific research work is the problem of combining these two aims—firstly of ensuring an adequate financial support for all fields of scientific work, with some system of priorities according to social need, and secondly an adequate measure of consultation with the individual scientists involved in the work of research.

It is necessary to argue against the idea that any attempt consciously to plan for research is bad. The idea amounts in fact to the proposition that things are best done blindfold—that conscious planning must be avoided.

There is a fear even among progressive scientists that planned allocation of resources will lead to misallocation, and the abuses of personal power of which contemporary examples are not lacking. The fear is that only the conformist, and generally the establishment men will be given good facilities for research.

The reliable safeguard lies in more democratic forms of organisation. Disasters need not follow from improved organisation, so long as the dangers of misdirection are kept in mind, and some heed is given to the opinions of the scientific workers involved.

The areas demanding scientific research attention (whether in natural, medical, agricultural or social science) increase the whole time in number. Scientific advance exposes new problems and reveals long standing problems as ripe for scientific attack. This process occurs more rapidly than the increase in

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trained scientific people and it is probably inherent in the situation. It presents the obligation to be selective in the choice of problems worthy of research attention. If we are not selective then research facilities will be used inefficiently. The front of progress will be advanced rapidly in certain areas but key sectors (on which general maintained advance depends) will be neglected. Nor will new points of special promise be encouraged to grow rapidly. So it is essential to have a strategy for the distribution of the funds available.

Quite apart from "mission-oriented" research which may be deemed vital, it should be possible to draw up a set of priorities for research which are intrinsic in the development of science itself. The advance of science depends very largely on the most highly general scientific advances. Such general growing points of science as arises from the development of computers and electronics, of biochemistry and of materials capable of withstanding extreme conditions, need a special place in the strategy.

Each of the Research Councils, in particular the Science Research Council, needs to accept this more positive role in discharging its responsibilities. But there is also a need for co-ordination of the strategies of the various Councils and also of those sections of the Ministry of Technology and other Government departments which are concerned with fundamental research. It is also important that overall studies should be mounted to investigate the optimum ratio that should exist in our country between fundamental research and developmental work and applications.

It is regrettable therefore that in its first Report the Council for Scientific Policy, which at the moment is the body best placed to exercise this co-ordination, appears to have turned its back on this role, and instead is restricting itself to influencing each Research Council individually by means of the general tasks and mechanics of growth mentioned earlier. It is also doubtful whether its links with the Ministry of Technology (as described by Mr. Wilson, the Prime Minister) are sufficiently organic to permit of a full review of all the fields of fundamental research, whether pure or mission-oriented. The complete divorce of military research from civil research is a further weakness.

The Problems that Remain

A more broadly based body, with an adequate number of permanent members and a good secretariat is surely necessary. Something like a National Research Council is called for with powers to provide an organic link between the research work of the two main Ministries, Technology and the Department of Education and Science.

These proposals for research strategy leave many essentials for further consideration. Many general services cry out for improvement—libraries, information services, abstracting, translating, and so on.

But the major problem remaining is that of the human resources. The brain drain has its origin only partly in the inadequate supplies of apparatus. Salaries, and salary structure, insecure employment in research fellowships, all need rapid improvement.

And the highly qualified scientist, alone, is only a part of the research team. He needs technical assistance from skilled personnel—glassworkers, analysts, spectroscopists, machinists, and so on.

A key position in university research is that of the post-graduate student—usually working for a Ph.D. degree. His conditions of training, supervision, and remuneration are vital to the progress of research. So far, in published plans for research, they have been given quite inadequate attention.

SECTION 3. THE HUMAN RESOURCES

The Scientific Research Worker

Fundamental research in Britain is carried out largely in the universities. Present studies on the explosive moulding of metals at Birmingham University are laying the basis for great economies in their use in the engineering industry. Research into the structures of proteins and nucleic acids in the Universities of Cambridge and London has given new perspectives to biology, and the effects are seen in the work of laboratories all over the world.

This research is carried out under the direction of the teaching staffs of our university departments of science (pure and applied). There are many important problems in the field of higher scientific education which concern them that have no direct bearing on research. It is not the purpose of this statement to discuss these. Yet it would be artificial and irresponsible to suppose one can consider the work of the university scientist as a research worker without taking into account his duties as a teacher.

Concern has been expressed that teaching efficiency is in many cases sacrificed to research interests. And there is considerable dissatisfaction not least amongst university teachers themselves as to the effectiveness of scientific education. Clearly some material incentive should be devised to encourage the devotion to undergraduate teaching that is often given largely to research, for example by reserving some senior appointments for those who have a special gift and inclination to concentrate their talents in this direction.

It would be shattering to British science if attempts were made to solve this problem along lines which would in effect cut down the amount of research carried out in our universities. We have been warned by the brain drain to the United States what the reaction of many university scientists would

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be. It is not necessary that they should be faced with this invidious choice in the use of their time and energies. There are measures that can be taken which will allow the university scientist to be more proficient, both as a teacher and as a research worker.

Every scientist and technologist is wise to "keep his hand in" at laboratory practice. His thinking is stimulated and it is more likely to be realistic if he ensures that he keeps a close acquaintance with the possibilities of instruments and techniques, which develop with ever increasing speed. But there is a job in research which only he has been trained to do; to read the scientific literature, to think creatively, to discuss; to select problems for study, to assess the significance of observations made, to design experiments, to pioneer radically new laboratory procedures, to write reports. He must have time and energy to do this and he will be inefficiently employed unless this is his major contribution to research.

That can be so if he can be relieved of the relatively routine laboratory tasks into which most research projects can be resolved.

Automation invades the laboratory to an increasing extent and laboratories in large-scale private industry make full use of this application as machines become available. Automatic instruments can carry out complex laboratory operations as well as, sometimes better than, the scientist could himself. There are aspects too of the scientist's thinking that now become unnecessary chores as computers become available. Here again the larger private enterprises are not slow to see their advantage. The fact is that with the explosive growth of modern science and of the specialised literature which keeps pace, the research worker needs as much help as he can get if he is to keep abreast with the development of his subject in reading, discussion and reflection.

The university scientist is not favoured in these respects anything like so well as his colleagues in private industry. Private monopolies know well enough that if they want a better return for their money then generally a bigger outlay is required, and they see that this applies to research as to production. The same principle applies to fundamental research in the universities but it is acted on reluctantly and we use our scientists working there inefficiently as a consequence.

There are some indications that technological research is to be given more financial backing in certain university institutes. It is very welcome but it is not enough. One might mention biology especially as a field of university research that is not being given the support it needs in men or machines, considering the problem in medicine and agriculture which depend for their solution on advances here.

The Technician

However even the most automatic aids in the laboratory cannot do everything. The nature of research is such that it will always demand a flexibility in its attack. Human intelligence, imagination and manipulative skill must be involved. Many of the tasks to be done fall within the competence of a qualified technician.

One thinks in the first place of the need for more technicians working in direct association with members of university academic staffs on particular research programmes. University research depends also however (as in other research institutes) on common technical services available to all research workers of one or more departments. In the universities these services are at present quite insufficient. Facilities and staff in workshops for machining, for electrical and electronic gear, glass blowing etc., are inadequate for the demands made on them; and absurdly so for the demands that would be made if they were properly equipped and staffed. Office facilities, typing services etc. are also poorly provided for.

There is a growing recognition that a good supply of adequately trained technicians is essential for the efficient conduct of research in universities and elsewhere. In fact, the Manpower Sub-Committee of the Science Research Council is now engaged in a statistical survey of the supply of and demand for technicians.

At present, however, there is a shortage of technicians in our universities and many are recruited on an *ad hoc* basis and remain for relatively short periods of employment. Many colleges rely very heavily on employing technical staff of this short term nature, for example people who are studying for "A" levels preparatory to obtaining university entrance. This results in a continual change of staff with consequent loss of continuity and efficiency. College authorities admit that it is necessary to employ such people to avoid a breakdown in the technical services to the departments. The position in Technical Colleges and Schools is worse.

There are deep-seated causes for this unsatisfactory situation. Low salary scales are only part of the cause; and the detailed negotiation of better salaries is primarily for the Trade Unions concerned. Of more general importance is the failure of the universities to give adequate training, and to operate a systematic and integrated training scheme linked to promotion and career prospects. (The training of medical technicians and of technicians in some industries is much more organised, and in some ways can serve as an example. But it must be realised that the universities are a major employer of technicians and therefore their shortcomings are of great importance.)

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Essentially, universities need to take responsibility for "apprenticeship training" within the universities or "training on the job". There are opportunities for day release and attendance at courses in technical colleges and these must continue. But in addition, the universities must provide training within the departments. In many ways, universities may be compared with substantial industrial concerns in the number of technical staff employed. Yet there are many sections within departments which evade the problem of training by taking on no Junior Technicians at all.

A University Training Scheme needs to be organised as a single scheme covering the whole university. For this Juniors must be appointed, in the first instance, by the university centrally rather than by individual departments. A Training Officer needs to be appointed, covering the whole university, to organise the training schedules for Junior Technicians, and to supervise their attendance at further education classes. In each *department* someone should be in charge of the work of Junior Technicians, with the responsibility of arranging (in consultation with the University Training Officer) the daily work of the Junior.

The training scheme should be based on an entry as Junior Technician at age 16. For the first year the training should be as general as possible, the Junior spending periods of 3 months in different kinds of work. Only at the end of this year should any division or specialisation begin. The proper priority needs to be given to training and when a Junior is due to be moved from one section or department to another, the training schedules need to take precedence over any special demands of work within the departments.

After a suitable period of training, the Junior should "settle down" and join the establishment of a department. Further training should be selected to suit his individual specialities and the needs of the department.

The training of a technician should make possible a smooth transition to further training for higher qualifications. At the present time it appears difficult to progress from taking the City and Guilds Laboratory Technicians course at Ordinary and Advanced Level to taking National Certificate courses except by starting the latter near the beginning. This barrier should be removed.

The Post-Graduate Research Student

An expansion in the numbers undergoing post-graduate training for M.Sc. and Ph.D. degrees is another crucial factor for stimulating the progress of fundamental research. Post-graduate students are the apprentices in scientific research and the first obligation of the university scientist towards them is to ensure that they do receive adequate training. One suspects that too often not enough thought is given to the choice of research topic and that the student receives inadequate surveillance to allow him to develop his talents to the full. The fact remains and it should be more widely appreciated that research students make a substantial contribution to the research achievements of our universities. The work they do merits a considerably higher reward than they receive at present as research training grants (£450 per annum not subject to tax) from the M.R.C., S.R.C., etc. It would not be unreasonable to propose that they should receive a salary comparable with, say, the earnings of a skilled worker in industry. However one might expect to receive wider support for a suggestion which coupled increased pay with some supplementary work. There is such work that could conveniently be done by research students which would also be of educational benefit to themselves and an advantage to the universities. It has long been the practice in a few universities to encourage research students in science to take part in the work of teaching; supervising tutorials with small groups of undergraduates at an elementary level and demonstrating in laboratory classes. Naturally they are paid for their work and they benefit also through the consolidation of their own understanding of their subject. The undergraduates benefit since there are not enough academic staff in most universities to allow these forms of teaching to make the impact they could do.

Democracy

The absence of real democracy at any level in the running of British universities militates against the most fruitful development of research. In effect the experience of the majority of university scientists is ignored when important research policy decisions are taken. Moreover these are occasions which provide opportunities for the general betterment of research through co-operation. Seeing, for example, a technological problem which clearly demands the attention of techniques and ideas which he is developing, the pure scientist might then choose for further work aspects which would be of greatest mutual interest in both pure and applied fields.

It has been argued several times in Section 2 of this article that there needs to be an extension of democratic procedure in research departments. This is particularly true of universities where so much fundamental research is done. Such a change will help both to get and keep the human resources of men and women scientists that our country will need in the future. It is also necessary for the success of the positive approach to the national planning of fundamental research which has been advocated. That planning in this field presents peculiar difficulties no-one would deny; for it to be carried out successfully, it must go hand in hand with increased democratic consultation at all levels.

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The Genetic Code

Bob Williamson

AT a time when the world is advancing at an incredibly rapid pace scientifically and technologically, the time lag between intellectual advances and their impact on the world around us has been diminished to next to nothing. We also live in a period of social and economic crisis, and this too puts a cutting edge on new scientific discoveries, for they can be used not only for social advancement, but also to advance war and hatred.

In such a context every aware person has an obligation to learn a bit about the new sciences, from nuclear physics and astrophysics to molecular biology and physical anthropology. I hope I will be able, in this short article, to outline the revolutionary jump in our knowledge which has taken place during the past fifteen years in molecular biology and genetics.

The offspring of all animals and plants resemble their parents, yet differ from them in detail. This simple statement is the foundation of genetics. The variation between individuals is as important as the continuity, for in variation we may hope to find clues to the way in which species evolve from one another in response to changing conditions.

There are many ways of studying the differences between individuals. Not all of these relate to genetics; an interesting survey on differences in teenage dress in Britain would not be of genetical interest. Geneticists study size and shape and colour, whether of peas or people. They study the ability to survive changes in environment, the removal of a favoured food or a change in temperature. Alternatively, it has proven increasingly fruitful to study the changes in the chemistry of living things which underly the other changes, which give the ability to survive or alter the structure or development of the animal or plant. Thus advances in biochemistry (the chemistry of living things) on the one hand, and the rapid development of the electron microscope and other techniques revealing the structure of the cell on the other, have provided genetics with tools enabling it to advance rapidly at this moment.

All Living Cells are Similar

Biochemistry has shown us that animals, plants and bacteria (or "germs") are not so very different from one another as they might appear. All are composed of cells, or are single cells, and these fundamental units of life are themselves made up of substructures which are very similar in all living things. The chemicals the cells contain, and the jobs they do, must have evolved very early in life's history on earth. All cells use carbohydrate (sugars and starches) for energy, and even plants, which are unique in being able to use the sun's energy, have to put it through chemical steps similar to those we use when burning sugars. Proteins are particularly important to the cell, for most of the "work" is done by these complex molecules. They are the machines carrying out the chemical reactions of the cell. They also contract in muscle, control nerve impulse transmission, break down our foodstuffs (and those of bacteria) into small molecules the cell can use, and carry out the million and one activities we associate with life. Like so many biochemical substances, proteins are very large molecules made up of many sub-units strung together, almost always in the same order in any one kind of animal or plant for any given protein.

The protein sub-units are called amino acids, and there are several different kinds, twenty in all. These have different electrical and chemical properties and are the reason why different proteins can do different jobs. Certain proteins are found only in one kind of plant or animal, specially fitting it for survival; other proteins seem to have changed little in evolution. Haemoglobin, which carries oxygen around the body, has changed very little during evolution from midge to fish to man. Thus a knowledge of how proteins are made, and what controls their structure, is essential to understanding how the cell works and adapts, in the same way as an understanding of machinery is necessary to fathom the working of a factory.

Living cells are not simple. Even bacteria, which can only be seen with the aid of the modern microscope, contain tens of thousands of complex chemicals, each of which has one or several functions, controlled to work in the interest of the cell as a whole. An animal or plant, with perhaps thousands of millions of cells, each specialised for some function or other, and interacting with one another, is far more complex still. It is for this reason that many biologists today prefer to work with bacteria, the simplest of the "complete" cells, and viruses, which cannot grow on their own but can reproduce when invading an animal, plant or bacterial cell. The results obtained using these simple systems seem to be applicable to more complex cells as well.

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The Language of the Cell

Any passage of information involves a language, or in other words, a code. When we wish to communicate information to one another, we do it with an alphabet and words, two sorts of code which man has socially evolved. The cell also has to pass information in order to function. Some kinds of information are used within the cell, to control its energy production, and perhaps just which job it will do. But of equal importance is the information which is passed from one generation to another, which ensures that a cell retains the capabilities of its predecessors. This is called genetic information.

In the past few years a lot of evidence has been found that all of the cells of an animal or plant have the full set of instructions for the "running" of the whole organism. For instance, one can start with a cell from a carrot stem, or leaf, or root, and grow the whole carrot. (Horticulturists have known of such findings for generations.) Similar experiments show much the same results with animals, since cells surgically moved from one part of an embryo to another can change their function quite dramatically. (Cells in adults lose this ability, but it is still thought they retain the full set of instructions.)

These are remarkable findings, for they mean that cells from an animal's liver, or heart, or brain, do not differ in their basic set of instructions. Every cell has the same "manual" as every other cell; what changes is the particular instructions from the "book" which are used at any given time.

In addition to proteins, the functional elements of cells, and carbohydrates and fats, used for energy, cells contain one other major class of chemical, the nucleic acids. Even viruses, which have a very simple "manual" which can only be used inside an infected cell, contain nucleic acid (and protein). The first evidence showing that nucleic acids were involved in heredity came from experiments which showed that it was the nucleic acid of the virus which carried the instructions into the cell; the protein, although important as a protective coat, was quite ineffective alone, while isolated nucleic acid could infect a cell.

Nucleic acids, like proteins, are very long molecules, made up of a number of sub-units joined by chemical bonds. I like to think of both as long strings of "poppet beads", of the sort popular about ten years ago; the poppets are different for nucleic acids, being rather bigger, and coming in only four colours, as against twenty for the proteins. How can the nucleic acid carry the information which enables the cell to decide which proteins to make and how to put them together?

There are two sorts of nucleic acid, DNA and RNA; DNA has one atom of oxygen less in every sub-unit (hence *D*eoxy) than has RNA. Every animal, plant and bacterial cell contains both DNA and RNA, but while the amount of RNA varies greatly from cell to cell depending on its function and the amount of food available, the amount of DNA for most cells is *exactly* the same. Not only is the amount of DNA the same for each individual, but it also seems to be the same for every member of a species, as near as we can measure. Moreover, the DNA is found almost exclusively in the cell nucleus, which has always been known to play a very important part in cell division and in control; during cell division the DNA is found in the chromosomes, wiry filaments which divide in two when the cell divides.

DNA—A Likely Candidate

It is evident that DNA has many of the properties one would expect of the genetic material, the chemical carrier of the information setting out the structure and function of the cell and the organism. It was found that some kinds of chemicals and radiation, which inactivate DNA, also change the structure of proteins in the cell. Many of the changes were dramatic—after treatment, a protein would just not appear at all. Sometimes, however, a protein appeared which was changed in just one of its amino acid sub-units, or to use our example, the colour of just a single poppet bead was changed. By mating bacteria to one another, it was shown that a single change to one of the DNA "poppets" had caused this single change in the protein.

How does the DNA pass its information on? It is at this stage that the other kind of nucleic acid comes in. If the genetic material itself were passed around the cell, there is every chance it would meet with accidents; in the same way, master sets of blueprints, or master gramophone record pressing discs, are carefully preserved. Copies of the DNA are taken using the similar substance RNA, and this goes into the cell, carrying the message to wherever the protein is to be made. Protein synthesis factories exist in all parts of the cell, and are themselves made of RNA and protein, but they seem able to use any set of instructions sent to them.

The kind of RNA carrying the message from the cell nucleus to the protein-making factories is called "messenger RNA". Once the message arrives the correct amino acids (protein "poppets") are strung together in the correct order, and the protein folds up into the right shape for the job it has to do.

The very small change which occurs when a single amino acid changes can be of tremendous importance to the cell, or even the animal. The change can cause the death of a cell, or of the living thing if it occurs in all cells. Just occasionally a change occurs which is beneficial to the cell. Perhaps a protein can carry out its job more efficiently, or the organisation of the cell is improved. Such changes are rare, but

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when they happen they will tend to be preserved, as the animal or plant will be better able to survive. We can record changes which happen in this way, either naturally or by using artificial radiations which cause changes to happen more frequently, and it has been shown that changes seem to occur at random along the DNA. Since the DNA is the only material which has been proven to carry information from one generation to the next, changes in heredity are due to changes in the DNA, and so far scientists have not found any suggested ways by which these changes can be other than random. The rate at which changes occur is influenced by the environment, but what the changes are doesn't seem to be determined in that way.

Parents and Children

So far we have been talking about heredity in two different senses as if they were the same—heredity from parents to children, and heredity within one animal, from one cell to another. While the genetic makeup of every cell in an animal or plant is the same exactly, there are differences between individuals within a single species. Differences between individuals are often due to different environments—obviously a well-fed child will *on average* grow to be taller and fatter than a poorly fed one. Even identical twins, those rare people with identical genetics, can be told apart if brought up differently. These differences arise because most living things (but not the most simple, the bacteria) inherit two sets of instructions, one from each parent.

A big problem arises here. The chromosomes, with the genetic information, occur as several pairs in cells. If an animal is to pass on its information to its children, and it has "duplicate copies", and the other parent is also to pass on the information, the child will get four copies (two sets of pairs). The next generation would get eight, and so on, a ridiculous situation. Because of this the sex cells undergo a unique process, where instead of having a pair of instructions, they divide an extra time without doubling their "master books", giving each final egg or sperm just a single chromosome. Moreover, this book is not just one of the two originals; in the last division the "books" get mixed together, so that some of the instructions come from each. This is why every child is not exactly like a mixture of its parents; heredity is shuffled about at each generation. However, although the changes are rung, new heredity can only arise if the DNA itself is changed, which (as stated above) happens only very rarely.

All of the cells which are going to be sex cells are already chosen when a child is born, although they do not fully develop until maturity. Since these cells do not take part in the general development of the animal, it is very difficult to see how they could be changed by changes in the environment, and experiments with many kinds of plants and animals have shown that heredity from one generation to the next is independent of the environment in which the parents have been brought up. Anyone who has thought about evolution should have suspected this even before it was proven experimentally, for evolution is a very slow process, much slower than would be expected were environmental changes to be immediately reflected in offspring. By selecting parents, one can combine several existing desirable traits quickly, but the introduction of new genetic information is a process which takes millions of years and seems to occur by chance.

I have mentioned above that we know now that the instructions on the DNA (in the cell nucleus) are copied on messenger RNA and passed into the body of the cell, where the instructions are translated and carried out. There is another big problem which has been solved during the past decade. The "instruction book" itself, the DNA of the cell, has to be copied whenever the cell divides, so that each daughter cell has a complete set. This happens thousands of times in the life of a plant or animal, and must occur with astonishing accuracy, for mistakes are almost never made. It is not necessary that every protein in the cell be divided when the cell divides, nor every biochemical, but merely the instructions for making them.

Duplicating instructions is not easy. Since we don't believe that Gods come down and make copies of the instructions, all of the duplicating during cell division must occur within the cell making use of information and material present in *every* cell. Not only that, it has been shown that half of the genetic instructions of each cell are handed on from the parent cell to each daughter cell, while the other half of the daughter's "information book" is made afresh.

The Structure of DNA

Watson, Crick and Wilkins put together two pieces of knowledge and explained the duplicating process by working out the chemical structure of the DNA. In DNA, which contains four kinds of "poppets", there are certain rules as to the proportions of each; in particular, the number of one sort always equalled that of another (let us say, red equals green and blue equals yellow). Secondly, when an X-ray beam is directed at a DNA molecule, a pattern is obtained looking like a "cross", which often indicates a chemical shaped like a helix, or spiral staircase. Crick and his colleagues suggested that DNA is not composed of one chain of "poppets", but of two, not identical to each other but "opposite", or complementary. If one chain has a

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red bead at a position, the other will have a green there, right down the length of the molecule.

This suggestion dramatically explains many of the problems of the genetic code. When the cell divides, the DNA molecule "zips" apart down the middle. Each half will attract exactly the right units opposite to it, and these can be stitched together in the right order while held by the existing chains. From one chain two have been formed, in a very simple process in which no new information has been brought into the system. Each new chain contains half of the original DNA, and half of it is newly made. The cell is ready to divide, and one DNA "double molecule" goes to each of the new cells. The correctness of the suggestion has been shown beyond doubt, in bacteria and higher cells, using radioactive "tagged" molecules which go into the DNA and following their path during cell division.

The messenger RNA is also a copy of the DNA, although only from one strand, and when it is made, the DNA does not separate completely, but comes back together again. As there are only four letters in the DNA-RNA alphabet, it takes a few letters in the DNA or RNA (three, to be precise) to specify one letter in a protein. It's as if one used a code where three-number sequences stood for letters: 123 for A, 345 for B, 724 for C, and so on. A single change (from 123, meaning A, to say 129, meaning P) in the DNA code changes a single letter in the protein code. This had been predicted by Linus Pauling some 20 years ago, but the mechanism is now understood.

Although changes of a fundamental kind are rare, they do happen. Germs are found which resist penicillin; flowers are found of new colours; children are born with physical or mental defects. These rare alterations, or "mutations", occur in the wild (as any farmer can tell us), but occur more easily in a controlled environment, whether in a laboratory or just a human environment with its fallout and its drugs. These changes, which have often been proven to be due to changes in the DNA, are usually harmful, for the cell is a delicate balance of different instructions perfected over millions of years. (This is why artificial mutants in agriculture, and highly selected strains, are often less hardy.) The rare helpful mutant will be more hardy, and thus will tend to pass on the character to its offspring. While the environment cannot *cause* changes in heredity, it can ensure that beneficial ones are preserved, and harmful ones eliminated.

The Causes of Mutations

Many natural things cause occasional mutations: cosmic rays, natural radioactivity, ultraviolet from the sun. These are still responsible for the great majority of mutations in all kinds of living things. Man-made agents can also cause genetic changes: X-rays, nuclear fallout, cancer-causing drugs (whether in industry or from cigarettes), and chemicals all alter the sequence of the poppets in the DNA. If the changes occur in a sex cell, which later joins with another to start an embryo, the change can run through the whole organism and lead to genetic disorders (such as mongolism and other genetically caused mental illness in human infants, and "sports" in animals and flowers). If the mutation occurs in an adult cell it will usually die. However, since DNA contains "controlling regions" which regulate the cell as well as "coding regions" for proteins, sometimes the cell goes out of control, and a cancer results. It now seems pretty certain that cancers are caused in many cases by changes in the DNA sequence, which lead to the cell going "out of control". The particular sort of control which cancer cells lose is the control over division, and thus they keep on dividing even when new cells are not needed by the body. The chemicals produced by cigarette burning are very similar to the "poppets" of the DNA, and this is no doubt the reason why 22,000 people die of lung cancer each year in Britain. The same is true of the chemical which caused several deaths in rubber workers last year. (This chemical, unlike tobacco, is now banned.)

Since the "business end" of a virus is its nucleic acid, viruses have long been suspected of causing cancer. In mice, this is known to be true, but it has never been proven for human cancers. However, viruses do "take over" the cell by replacing the cell DNA with its own nucleic acid, and sometimes in bacteria can actually change the cell nucleic acid too. The machinery in the cell factory is instructed by the virus instead of by its own DNA. Since virus diseases (such as 'flu) have replaced bacterial diseases as the major cause of what might be called "day-to-day illness", any effort to combat them must depend upon an understanding of the genetic code, and how the virus code replaces that of the cell.

It is not just cancer and virus disease investigations which will be revolutionised by the new discoveries. Zoologists and botanists are successfully applying the new knowledge to both theoretical and practical problems. One of the most promising is the study of memory. Memory exists in animals very much lower on the evolutionary scale than man; water worms and fish, for instance, show the ability to learn by their experiences. Although the story is by no means complete, it is now apparent that memory involves the synthesis of new molecules of RNA, which appears to carry the "memory message" at least for a time. When learning is taking place there is a very rapid synthesis of RNA in the very cells which are thought to be involved. Moreover, it

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has recently been claimed that if RNA is injected from a trained animal to an untrained one, the "memory" is passed on. If this should prove to be true (and there is still much doubt about some of these experiments) it would open up new possibilities, both excellent ones of increasing our power to learn and frightening ones of misuse and manipulation.

The Misuse of Biology

Many of us working in biology are becoming quite concerned at the possibilities of misuse. The nuclear physicists learned in the 1940s and 1950s that scientists cannot regard their work as "pure", for it can be used socially for political and military ends. Developments of "artificial memories" are still very far off, but development of potent viruses by mutation are certainly possible now, and are being explored, certainly in the United States and Britain, and no doubt in the Soviet Union as well. Alterations in genetics can be used to improve crops or to destroy men. The threats are no longer "simple" germ warfare or poison gases, but more subtle genetic changes, and gases causing psychological or memory effects. Fortunately most biologists are aware of these hazards, though in every country a few will be bought off to military establishments, offering high wages and good equipment. (Porton, in Wiltshire, is the British variant, although it has been paying some attention to its public image recently and been acting as a large scale production centre for certain organisms needed in other laboratories, as well as carrying out its more gruesome business, no doubt.) More difficult is the problem confronting hundreds of ordinary scientists, who realise that their work, although itself peaceful, could be perverted to dangerous uses. The Pugwash conferences have recently been considering this problem informally, and it is to be hoped that this body of leading scientists who have taken an interest in the peaceful uses of science will be able to propose courses of action before such situations arise.

The discovery of the genetic code, coupled with corresponding developments in biochemistry, have revolutionised the teaching of biology in the universities. Most leading biological departments today prefer their students to enter with school leaving passes in mathematics, chemistry and physics; the traditional approach to zoology and botany as taught in so many schools can be more of a hindrance to later progress than a help. A revolution in the content of secondary schools biology courses, and a big increase in expenditure on equipment, is urgently required.

Integrated research teams and departments specialising in developmental biology (the way in which the genetic information is used, switched on and off, during the development of the embryo into the adult) and cell biology (studying structure and function at the cell level, in between the chemical level and the study of whole plants and animals) are springing up all over Britain. Even so, we are spending far less on these fields than other countries, and especially the United States. In spite of this, we have many of the leading scientists in these fields working in British universities and research institutes, and a fine record of international honours. One of the most dangerous aspects of the present recession is that it will send many of these people abroad, for while they feel affection for Britain, they can only do this kind of work if advanced facilities, which cost money, are provided. Emigration of our best qualified scientists will in turn affect the teaching of new talent, and it is for this reason (and not because of sterile nationalism) that emigration must be resisted. Such a downward spiral, once entered, is difficult to recover from.

Lysenko

I feel it is impossible to write on genetics in a Marxist journal without mentioning, at least briefly, the sad period of Lysenko. While I feel a political evaluation is now possible, even on the facts available in this country, I will in the main confine myself to a few comments on the scientific aspects of the controversy. Lysenko and his followers claimed that there were certain periods in the development of an individual when acquired characteristics or environmental effects became incorporated into the genetics of the animal or plant involved.

There was already a great deal of evidence opposed to this view in the late 1940s, as well as good theoretical reasons for doubting it. However, the genetic code and the detailed and key role of nucleic acids was not worked out until some ten years later. Lysenko was thus by no means the only scientist who was incorrect on this point, for the facts could not at that stage be said to prove *conclusively* that heredity is, in the normal sense of the phrase, independent of environment. (I might add that, in my view, and admittedly benefiting from hindsight, the evidence did even at that time conclusively rule out the opposite view in the way it was put by Lysenko.) Lysenko also denied that chromosomes were the key transmission factors in heredity.

Much of Lysenko's published scientific work is impossible to repeat, for detailed experimental instructions are not given, and in other cases attempts to repeat the work have not been successful. What Lysenko did do was to take the role of "the champion of practical agriculture" against the "theoreticians" in the universities and institutes.

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That this gave him power can be understood if one bears in mind three factors. First, in central Europe (and to a lesser extent, in this country) scientists are isolated from the mass of the people and hence often develop snobbish and contemptuous attitudes towards them. It is thus easy to raise popular prejudice against them. Second, the Soviet Union was facing a serious agricultural situation, and the Party leadership wanted to hear that it could be solved easily (by radical changes in environment) rather than only with difficulty; the leadership thus threw its influence behind Lysenko. Last, during the Stalin period decisions of all kinds were often taken by decree, and it proved very easy to extend this method of work into scientific fields.

Soviet biology still suffers greatly from this period, when those holding the views of the mainstream of genetic thinking were not permitted to work and in some cases persecuted and even imprisoned. Today genetics, molecular biology and cell biology are beginning to establish centres of excellence once more in the Soviet Union, but it will take many years before the gap in research and training is made up.

Scientific problems can only be solved by an experimental approach, and such an approach is, in my experience, most fruitful when it flowers in an environment where different scientific theories are permitted to contend freely. The practical consequences of theory are the responsibility of the community as a whole (including the scientists), but this must never be used to prevent controversy and experimentation in the natural sciences. It is quite important that this subject be discussed amongst British Marxists, for there is still considerable mistrust within the scientific community of our motives and possible actions.

No article of this length can do more than scratch the surface of the new developments in molecular biology and genetics. For those who already have some knowledge of science (say, A-levels or so) may I recommend a fine book by Professor J. D. Watson, *The Molecular Biology of the Gene*, published by Benjamin (Amsterdam) in 1965. (A paperback edition is available.) For beginners, there is no perfect solution, but I would suggest reading a book by Ruth Moore, *The Coil of Life*, published by Constable (London) in 1961. On Lysenko, we must await a detailed analysis, perhaps in this very journal, and I hope it will not be too long in coming.

DISCUSSION CONFERENCE

(By Invitation)

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Discussion contribution on:

The Nature of the State

James Harvey

ALTHOUGH Ian Brownlie's article on the "Nature of the State" (*Marxism Today*, October) raises several very important questions, it does so in a way which seems to imply (though he nowhere states this explicitly and I may have misunderstood him) that the Marxist theory of the state as developed by Marx, Engels and Lenin is on the whole adequate for our purpose today. I think, on the contrary, that this theory stands in urgent need of development in a number of directions.

Lenin's *State and Revolution* is a good starting point for consideration of Marxist political theory. It exerted a tremendous influence on the development of this theory and rightly remains the most widely-used textbook on the subject. Yet it was written on the eve of the October Revolution, and like all Lenin's writings it needs to be understood in relation to the stage reached by the Russian working class at the time. It does not represent the whole of the views which Lenin held at that time on some aspects of the subject and naturally does not include ideas which he developed at later stages of the revolution. This is particularly important in relation to his ideas about bureaucracy and the withering away of the state. Lenin assumed that, in setting up its revolutionary dictatorship, the working class would smash the capitalist state bureaucracy and replace it "not by a state of bureaucrats, but by the armed workers":

> "The exploiters are naturally unable to suppress the people without a very complex machine for performing this task; but *the people* can suppress the exploiters even with a very simple machine, almost without a machine, without a special apparatus, by the simple organisation of the armed masses." (*Selected Works*, 1937 edition, Vol. 7, p. 83.)

In this sense, Lenin claims, "the state begins to wither away" and referring to the Paris Commune he says that it transformed the state (a special repressive force for the suppression of a particular class) into something that was "no longer really a state". He also writes that capitalist culture has created large-scale production, factories, railways, etc. and on this basis the great majority of the functions of the old state power have become so simplified that they can be "easily performed by every literate person" for ordinary workmen's wages (p. 42). He attacks Kautsky for saying that "we cannot do without officials in the party and trade unions, much less in the state administration" (p. 107) and he foresees the withering away of all bureaucracy taking place gradually as:

> "the functions of accounting and control—becoming more and more simple—will be performed by each in turn, will then become a habit and will finally die out as the special functions of a special section of the population." (p. 48.)

It is true that he does say at one point "there can be no thought of destroying bureaucracy immediately, everywhere and completely. That is Utopia." (p. 47.)[1] Nevertheless, the experience of the Soviet Union shows that in these passages in *State and Revolution* Lenin had seriously under-estimated the amount of time required for the elimination of bureaucracy. In practice it proved impossible to do without some of the old Tsarist officials as well as the experts; and the need for a powerful centralised administrative apparatus asserted itself almost immediately after the revolution and even to this day, nearly fifty years afterwards, there is not much sign of any withering away. In March 1919 Lenin described the problems of bureaucracy in much more realistic terms than in *State and Revolution*:

> "We can fight bureaucracy to the bitter end, only when the whole population participates in the work of government . . . the result of this low cultural level is that the Soviets, which by virtue of their programme are organs of government *by the toilers*, are in fact organs of government *for the toilers*, by means of the advanced stratum of the proletariat, but not by means of the toiling masses. . . . Here we are confronted by a problem which cannot be solved except by prolonged education. At present . . . the stratum of workers who are governing is an inordinately, incredibly thin one. (*Selected Works*, Vol. 8, p. 353.)

And at the beginning of 1921 he said "Can every worker know how to administer the state? Practical people know that this is a fairy tale . . .".[2]

[1] Lenin also realistically pointed out in *Can the Bolsheviks Retain Power?*, written just after the revolution, that equality of pay for all work could only be introduced gradually, leaving a higher rate of pay for engineers, agronomists, and technicians. (*Selected Works*, Vol. 6, p. 270.)

[2] *Collected Works (2nd Russian edition)*, Vol. 26, p. 103.

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In the last months of his life Lenin was preoccupied with the dangers of certain bureaucratic developments in the Soviet state which were particularly associated with Stalin—Stalin's treatment of the Georgian nationalists and the methods of work of the Workers and Peasants Inspection which was headed by Stalin. It was these developments that seem to account for the harsh criticisms of Stalin, in Lenin's testament written at the time, in which Stalin was described as "rude" and unfit to hold the post of general secretary of the party.

Introducing his proposals for reorganising the Workers and Peasants Inspection Lenin wrote in January 1923 that "With the exception of the Peoples Commissariat for Foreign Affairs, our state apparatus is very largely a survival of the old one, and has least of all undergone serious change".[3] In March 1923 he wrote that "the situation in our state apparatus is so deplorable, not to say outrageous, that we must think very carefully how to remedy its defects . . ." and "Let it be said in parenthesis that we have bureaucrats, not only in the Soviet institutions, but also in the Party institutions".[4]

Lenin was always ready to revise his theories to take account of new developments. But the theory of the withering away of the state by means of the participation of the workers in the work of administration, as set out in *State and Revolution*, became a dogma in the Soviet Union under Stalin and was still held in 1963 by the authors of the *Fundamentals of Marxism-Leninism* (2nd edition, 1963) who wrote that "Work in the government apparatus will eventually cease to be a special profession and all citizens will be drawn into administering the affairs of society" (p. 671) and "State bodies are gradually being transformed into bodies of public self-government" (p. 674) "Thus, the withering away of the state is a complex and contradictory process" (p. 675). But they do not give sufficient facts to support these generalisations which seem (though more information is badly needed) to be more in the nature of pious aspirations for the distant future rather than a realistic description of current developments in the Soviet Union.

I do not wish to pursue here the developments which took place in the Soviet Union after Lenin's death. It is sufficient for the examination of *State and Revolution* to note that, even in Lenin's day, bureaucracy had grown up in the state apparatus and in the party.

It does not follow, of course, that because the theory of the withering away of the state set out in *State and Revolution* requires to be modified in relation to the Soviet Union, it needs to be modified in relation to the transition to socialism in Britain. Nevertheless, there are good grounds for thinking that it does. There has been a tremendous technological development of the productive forces since 1917 and changes of great magnitude, in connection with automation, are taking place. But there is no clear evidence that these changes are making the work of managing the economy, and the functions of accounting and control, simpler than they were before. On the contrary, they seem to be tending to become, if anything, more complex.[5] An extensive apparatus of permanent officials, managers and technicians still seems inevitable for a long time to come.

The Meaning of Bureaucracy

What exactly do we mean by bureaucracy? Surely it is connected with the element of compulsion that pervades the functioning of an administrative apparatus, both in a capitalist and in a socialist society. A state apparatus is composed of persons in a privileged position placed in authority over the population and whose decisions are in the last resort imposed on the people by the force of law. Socialism was established in the Soviet Union approximately in 1936, when collectivisation was in the main complete, and thereafter the state lost its former function of class oppression; but compulsion has continued in the relations between state and people. However, in the *Fundamentals* there is only a partial recognition of the role of compulsion: "coercion is now used not against classes or social groups but against individuals who violate the laws of society" (p. 597). The economic role of the state is "substantially enhanced" and the cultural and educational function of the state becomes widely expanded; "in socialist society . . . the state acts primarily as the organiser of economic and cultural development". Here it is implied that compulsion is only used by the police and law courts against individuals who break laws and that the work of economic organisation does not entail the use of compulsion.

But this is surely too restricted a use of the word "compulsion". There is compulsion whenever a decision, which affects the lives of some people and to which they have not consented, is made by an official placed in authority over them. They are compelled to accept it because they have no alterna-

[3] *Selected Works*, Vol. 9, p. 382, and see E. H. Carr, *The Bolshevik Revolution 1917-23*, Vol. 2, p. 186 (now available in a Pelican edition of 3 vols.).

[4] *Better Fewer, but Better*, *Selected Works*, Vol. 9, pp. 387 and 394.

[5] Maurice Cornforth, in *Marxism and the Linguistic Philosophy*, p. 330, suggests that, even though planning may be becoming more complex, the advance of computing and similar techniques will make the planning authority superfluous; planning will become automated. This may conceivably happen, but it is surely a very long way ahead.

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tive. Decisions of this kind are made every day by a capitalist state apparatus, ranging from key decisions about the location of a new steel plant or a new town or tax changes down to decisions allocating new council houses or refusing unemployment benefit and so on. Those who take these decisions are part of the bureaucracy which Lenin saw as one of the two central features of a capitalist state (the other being a standing army). An element of compulsion is also inevitably present in the decisions taken by officials in a socialist state apparatus, from the key decisions about planning the economy, about investment, the price of food, etc. down to a multitude of lesser decisions, where the people affected have not been fully consulted and have not had the opportunity to participate in taking the decisions.

If an extensive apparatus of officials and technicians will be needed in a socialist society, as was suggested above, it follows that administrative compulsion will be widespread at the inception of a socialist state.[6] Moreover, since the state will take over a large part of the means of production, there may actually be more administrative compulsion, in some directions at least, than there was before under capitalism.[7] In the early stages of socialism, then, it will be necessary to secure a continuous strengthening of popular control over the officials, and to develop for this purpose all our democratic traditions along with new forms of public activity—with the ultimate aim of ensuring that decisions are never taken until those who are affected by them have been consulted and are in agreement. The aim will be, not the withering away of the state, but the withering away of all compulsion in the relations between the state and the people.

Coercion and Consent

Although the element of compulsion pervades all the activities of the state, the British ruling class maintains its domination over the working class, not in the main by coercion, but through the force of ideas which secure the consent of the working class to its rule. In society as a whole the element of "consent", of persuasion through ideas, is interwoven with the element of coercion exercised by the state. When the element of consent is strong, coercion may become less important, and vice versa. At any given moment there is established between them a certain balance, or equilibrium, and this will be continually disturbed and re-established with every shift in the relation of class forces. The complexity of this relationship between coercion and consent can be illustrated by mentioning three aspects only (others may be more important). First, state institutions operate in accordance with certain traditions and ideas held by the employees of these institutions, whether they are soldiers, policemen, judges or officials. Second, the ruling class uses these institutions to influence people's ideas about the state, and strives to perpetuate a series of myths in connection with particular institutions: the civil service (myth of neutrality), the social services (myth of the welfare state) and the various myths associated with Parliament, etc. Third, various state institutions impose ideas on the people, e.g. the education system plays a part in moulding the outlook of children and young people.

Perhaps these examples are enough to show the intimate connection between ideas and coercion in our society, and to suggest that it can be sometimes misleading to consider one in isolation from the other. Yet *State and Revolution* is mainly concerned with the coercive aspect. Throughout the book there is a pre-occupation with violence: "The state is a special organisation of force; it is the organisation of violence for the suppression of some class." The situation is different in Britain today. The character of the transition to socialism will determine the relation between coercion and consent in a socialist society, and this in turn will have a profound influence on the nature of the administrative apparatus and the degree of compulsion which it will exercise.[8]

The Independence of the State

The problem of bureaucracy under socialism can be approached from another direction. It is common for Marxists to refer to the state as the "instrument" of the ruling class, and as its "representative". These terms, especially the word "represent", raise a host of difficult questions. In practice a

[6] The term "bureaucracy" has come to mean something bad and unnecessary. This creates a problem in terminology, because compulsion in the relations between officials and the people under socialism cannot be eliminated immediately and indeed has a positive role to play in strengthening socialist relations of production. For this reason I have preferred to use the rather clumsy term "administrative compulsion" in place of "bureaucracy".

[7] Cornforth, op. cit., p. 328, where he suggests that under socialism "some of the alienation effects experienced under capitalism may even be accentuated. For the power and scope of impersonal organisation, and its control over the direction of what people do, increases".

[8] It is impossible to go further into this question here. It was explored from many different angles by Gramsci. See the *Modern Prince and Other Writings* (English translation published by Lawrence & Wishart, 1957), p. 124. This valuable selection of Gramsci's Prison Notebooks and other writings is now unfortunately out of print. It does not, however, include the most important passages in the *Prison Notebooks* on this problem.

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capitalist state has not usually represented, in any precise sense, the whole capitalist class. It may have a degree of independence. The following passages are taken from the *Eighteenth Brumaire*, which contains the most thorough analysis of an actual state—the French state under Napoleon III—which Marx ever made:

> "Only under the second Bonaparte does the state seem to make itself independent. As against civil society, the state machine has consolidated its position so thoroughly that the chief of the Society of December 10th suffices for its head . . . and yet the state is not suspended in mid-air. Bonaparte represents a class, and the most numerous class at that, the small-holding peasants. . . ."
>
> "Their representative must at the same time appear as their master. . . . The Bonaparte dynasty represents not the revolutionary but the conservative peasant. . . ."
>
> "As the executive authority which has made itself an independent power, Bonaparte feels it to be his mission to safeguard 'bourgeois' order . . . looks on himself as the representative of the middle class . . . but has broken its political power . . . but by protecting its material power he generates its political power anew."[9]

Thus, although Marx makes it clear, both in the last sentence of the third passage and elsewhere, that the central function of the Bonapartist state was to preserve the capitalist system, he also sees that the state had a certain independence in relation to the capitalist class and was not simply its representative or its instrument. The relation between the state and the ruling class was more complex than that. The political influence of the small-holding peasants was to some extent reflected in the character of the state, even though it remained essentially a capitalist state.

Lenin only refers once in the *State and Revolution* to the state "acquiring a certain independence" when, after quoting the passage in *Origin of the Family* where Engels gives a number of examples of this,[10] he says that another example is "the present Kerensky government in Republican Russia since it began to persecute the proletariat".[11] There is, however, no further analysis of the problem in *State and Revolution* as it was clearly not important for Lenin at that time. Yet it can be crucial for an understanding of the role of the state. The British capitalist class has in the past very often been closely linked with a particular section of capitalist interests rather than with the capitalist class as a whole. Its domination during much of the eighteenth century by the tiny group of Whig landed aristocrats is a well-known example.

Thus the capitalist state at any moment of history is unlikely to represent the capitalist class in any pure sense because (1) a particular section of the capitalist class may have a dominating influence—giving rise to possible conflicts, e.g. between the monopolist and the non-monopolist sectors at the present time, and (2) the class struggle in society may be reflected inside the state apparatus and in its mode of operation.

State Monopoly Capitalism

The question of the independence of the state assumes a special importance under state monopoly capitalism. This is not the place to make a thorough analysis of the transformation of monopoly capitalism into state monopoly capitalism.[12] The two main causes appear to be: the rapid rate of technological change in recent years, continually strengthening the social character of the productive forces, and the growing strength of world socialism. These two forces have created a series of political and economic problems which have compelled the state to extend its economic activities on an ever wider scale. Although the first signs of state monopoly capitalism were perceived by Lenin as long ago as 1917,[13] and further developments took place in the 1930s, it is during and since the last war that the growth of state monopoly capitalism has been so rapid in Britain and in all the advanced capitalist countries. Marxist writers have in the past tended to stress its negative characteristics, seeing it only as the instrument of the monopoly capitalists. The positive aspects have been neglected. The growth of state intervention in the economy is only accepted reluctantly by the ruling class as it contradicts the idea that profit is essential for economic success. It also creates more and more opportunities for the labour movement to influence the character of state

[9] Marx and Engels, *Selected Works*, Moscow 1951 edition, pp. 302-308.

[10] Engels wrote: "Exceptional periods, however, occur when the warring classes are so nearly equal in forces that the state power, as apparent mediator, acquires for the moment a certain independence in relation to both." 1940 edition, Lawrence and Wishart, p. 196. Engels illustrates this by saying that absolute monarchy balances nobility and bourgeoisie in the seventeenth and eighteenth centuries, Bonapartism of the First and particularly of the Second Empire balances proletariat against bourgeoisie, and in Bismarckian Germany, capitalists and workers are balanced for the benefit of decayed Prussian cabbage-junkers. The idea of "balancing" seems to be carried rather far here and applies Marx's conception of independence in a rather mechanical and not wholly convincing way.

[11] *Selected Works*, Vol. 7, p. 14.

[12] See the report of the International Conference on state monopoly capitalism held at Choisy-le-Roi on May 26th-29th in *Economie et Politique*, June-July, 1966.

[13] *The Threatening Catastrophe and How to avoid it*, where he described state monopoly capitalism as the "threshold" of socialism.

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intervention and to turn it in a democratic, rather than a capitalist, direction.

Precisely because of these growing opportunities, the extension of state economic activities has been accompanied by an increasingly authoritarian trend throughout the state apparatus and society. The drive for an incomes policy, now reinforced by legal sanctions under the Prices and Incomes Act, is only the latest example, showing that state monopoly capitalism is less and less able to tolerate an independent trade union movement.

Democracy and Socialism

The struggle for changes in the whole character of state economic activity is therefore not merely an economic, but also a democratic struggle—and as it gains support it will not remain purely democratic, but is bound to open up the perspective of advance to socialism. In *State and Revolution* Lenin refers to "the need to develop democracy to its logical conclusion" (p. 72) and to "the interesting boundary line at which consistent democracy is *transformed* into socialism and at which it *demands* socialism" (p. 71). This was one of the most important parts of Lenin's thinking and was developed much more fully in his other works where he dealt with the relation between bourgeois and socialist democracy. Thus in 1921 he wrote:

> "We brought the bourgeois-democratic revolution to *completion* as nobody has done before. We are progressing towards the socialist revolution consciously, deliberately, and undeviatingly, knowing that no Chinese wall separates it from the bourgeois-democratic revolution. . . ."[14]

For Lenin the bourgeois-democratic revolution was mainly concerned with the building of an alliance between the working class and the peasantry. There is an urgent need to develop Lenin's theory in relation to state monopoly capitalism. It is noteworthy, for example, that in the *British Road to Socialism*, democracy is treated in a rather formal manner, as something that will be extended by a socialist government after it has come to power. In the section headed "The Way Forward" the struggle to build a united movement is to be based on the fight for a higher standard of living, for peace and for colonial freedom. The struggle for the extension of democracy is not declared to be an integral part of the struggle for socialism.

The *British Road to Socialism* also declares: "One thing is clear: socialism can only be built with power in the hands of the people, led by the working class. This was the significance of the taking of power by the Russian working class in November 1917, by the Chinese workers and by the workers of other countries in the years following the second world war." But it is no longer clear that the transition from state monopoly capitalism will take place in this way. Since the social character of the productive forces is already impressing itself on the state under capitalism, the working class have the opportunity to narrow down the power of big capital before political power is gained, and to compel the taking of measures which earlier were only contemplated as being taken after political power had been gained. It used to be basic for Marxists that the transition to socialism was different from the transition to capitalism. In the course of the transition from feudalism to capitalism the productive forces did not come into sharp conflict with the productive relations, and a substantial development of capitalist productive relations took place before the capitalist class gained political power. The bourgeois revolution was based on the fact that bourgeois productive relations, already developed, were restricted and hemmed in. But the contrast between the two types of revolution can no longer be drawn so sharply as it used to be. Two separate stages used to be envisaged: first, a struggle to win political power, transforming the capitalist state into a socialist state; second, the socialist state nationalises the principal means of production and carries through a far-reaching extension of democratic rights. But the special characteristics of state monopoly capitalism open up a new perspective in which these two stages are no longer so clearly separated as before.

A New Perspective for Socialist Democracy

Earlier I said that "administrative compulsion would inevitably be widespread at the inception of socialism". This statement can now be seen to be over-simplified. The word "inception" is misleading, because the transformation of the state and the building of socialism is likely to extend over a period; and throughout this period, reforms which succeed in narrowing down the economic and political power of state monopoly capital will necessarily have a democratic character and will strengthen the element of popular control over the state. It has often been asked how there can be any guarantees that the kind of bureaucratic state apparatus which was built up in the Soviet Union after the revolution—and which still retains features which are deeply unattractive to many British people—would not be created by a future socialist government in Britain. The answer lies, not so much in making promises about what a socialist government will do (as in the *British Road to Socialism*: "A socialist government will preserve and extend civil liberty . . ., etc.) but in the character of the struggle against state monopoly capitalism, which is so very different from the struggle against Russian capitalism in 1917.

[14] *Selected Works*, Vol. 6, p. 500.

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No Room for Homo sapiens?

Jack Dunman

COMRADE CHATER has made ample amends for his rather hasty article in *Comment*, and has brought out well the urgency of increasing food production. In this country, we produce more per acre and more per man than almost any other (exceptions are Belgium, Holland and perhaps Denmark, and in no case is the margin very large); and we have the smallest proportion of our working population engaged in it of any country at all. Perhaps one day we shall take seriously our own relative efficiency in this field. If any country can make a contribution to the agriculture of other countries, it is ours. And this does not only apply to technique, science and general know-how; it may well apply to the way in which the industry is organised. This is a new thought; but it was provoked by a passage in Comrade Chater's article, where he says:

> "reorganise the social relations of production in the underdeveloped countries so that the peasants can be liberated as a prelude to gathering them together in large-scale state and co-operative farms."

I have become more and more doubtful whether "*large-scale* state and co-operative farms" are really going to be the answer in many countries, if any at all.

What is Large-Scale?

Much depends on our interpretation of "large-scale"—but for most of us we have thought of the largest Soviet state and co-operative farms, with 20 to 50,000 acres, and several hundreds or even one or two thousand members.

In the other socialist countries, varying degrees of "collectivisation" have been applied, some even higher than in the Soviet Union (i.e. less activity on private plots) and some very much less, down to Poland, where there is virtually an individual peasant economy. For a few years it even appeared that the Poles were increasing production faster than the others, but now it is understood that they are having some difficulties. Let it never be forgotten that the socialist countries have increased and are increasing, in general and over a period (there are local setbacks due to weather vagaries) food production faster than either the capitalist or the newly independent countries. Nevertheless, it is nowhere hidden that a sufficiently rapid and reliable increase in food production remains one of the most intractable problems of socialist construction.

Perhaps because agriculture deals with living things it is especially important to beware of size for its own sake. I remember a GDR collective farmer proudly claiming that one man looked after 10,000 pigs; and a British farmer who was with me replying: "But you must remember pigs are human". (He meant they are alive, and require individual attention; and he thought 5,000 was about the limit.)

Recently, *Soviet News* reported that experiments were being made in organising production on a much smaller basis. Collective farms were not being dissolved or divided; but full responsibility for all aspects of production were being given to small groups consisting of an equivalent to about six families.

We need a lot more information but it suggests our traditional approach, which Comrade Chater has made, may have to be very much revised.

Especially in underdeveloped countries without much machinery, this form of organisation, where people are responsible for and able to follow through the growth and development of living things, whether plants or beasts, may be the only one possible, *and may prove to be the best to carry on with* even when machines become more plentiful.

British Experience

It is interesting that in Britain we have a very highly developed large-scale and efficient agricultural co-operative movement for supply of requirements and marketing of products, which did trade to the value of about £200 million in 1965, which is about one-twelfth of the total trade done, and limiting the power and profits of the middle men and even to some extent of the big monopolies.

Alongside this, during the last few years there has been a spontaneous growth of "Groups"—tiny and informal organisations of perhaps only three or four members, around a commonly-owned machine and which involved co-operation *in production*. There is an interesting link here with the new Soviet arrangements; and it justified my remark that in Britain we may have something to contribute on the actual organisation of the industry.

The movement is only minute so far, but it could be encouraged. It is a move towards larger scale operation based on actual techniques, and not size for its own sake, and acceptable to the farmers themselves. If it spreads it could be, if not a move towards socialism, at least a clearing of the ground for socialism in this most difficult but most important industry.

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M. N. Seedo

TWO basic principles of Marxism answer, in my opinion, the whole argument of Ivor Montagu.

One of the two consists in the Marxist theory that man can produce more than he consumes; and the second one says that the chief need of human beings is other human beings.

When isolated from each other the two statements soon dwindle into superficial sentimentality and mediocrity. But in their dialectical unity lies their greatness. And it is that dialectical unity between the two statements which makes Marxism the most embracing and the most realistic social theory ever discovered by man, even more true today than it was of the days when it was written.

The fact that the greatest need of human beings is other human beings, which is closely connected with the fact that man can produce more than he consumes, shows that the need for other human beings is due not only to psychological causes, not only to emotional, intellectual, sexual interests (those, of course, are there and are, undisputably, strong enough), but man has also a need for a kind of communication which is based on economic interests, based on the achievements that the economic co-operation between the productive human forces brings, as well as on the mutual creative resources and possibilities that people afford to each other.

Man's Productive Capacity

An individual on his own on a desert island could not survive. And even if he should have the most inventive brain, be the strongest of men, the most ingenious person; even if he, or she, should perform miracles, and survive for a short time without other people, one may be sure that a great deal of that person's inventiveness and ingenuity is based on the utilisation of what stuck in that person's memory from the things that he, or she, had previously learned from the people he, or she, lived with, before his or her ship capsized and landed him or her on the desert island.

Man can produce more than he consumes. So much more, that his powers of producing all the socially necessary commodities can provide for the children and for the old, for the sick and infirm, and even for the grossest abuses, exploitation and misuse on the part of innumerable human parasites who grow fat on the usurped products of the working classes.

Man could not have departed very far from the state of cannibalism if it were not for that wonderful quality he has of producing more than he consumes. All the human forms of production are based on that quality. And when human beings co-operate in their productive activities the end result grows geometrically, not arithmetically. It is then that quantity changes into quality. For the same number of people could never have created anything so fascinating, so breathtaking and so revolutionary without co-operation. Man could never have produced such a technique and industry as we have without direct, and, even more so, without indirect collective effort, and communication. Through books and through machines, through telephones, telegraphs, arts and sciences, human beings communicate. Human ways of communication run through different space-time stretches. On the field of human production and human communication quantity changes into quality in the most concrete and most astounding forms and proportions.

Man, or, to be more specific, the working man, is not always aware of his great magic qualities. *But the exploiters are.*

From time to time, when robbed of the surplus value that he produces, man is unable even to feed his family, let alone to keep his family in the luxury and comfort to which he is entitled. Then he often gets frightened of the very sources of his strength and power. He gets frightened of the machine, which can only help him produce even more than ever before, he gets frightened of the increase in population which actually can lead to prosperity, to further development, to greater invention.

Men and Machines

Again, is there a contradiction between automation and the need for more people? Not at all. Automation could surely provide more leisure, more riches and more comfort for man; it would provide more efficiency, more dignity and purpose in the application of man's abilities, but it could never dispense completely with man himself. On the contrary, automation requires more human skill, and human skill can be acquired only through the use of a greater quantity of work often mental work and learning in the acquisition of the skill. It also requires a greater division of labour in order to free the skilled worker from the drudgery which interferes with the application of his skill, and so on. A man operating a computer cannot afford to waste his time on cooking his meals, washing his shirts, cleaning his windows, building his house, decorating his rooms and so on (unless he wants to play around in his spare time with some such

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things occasionally as a kind of recreational hobby). More and more people have therefore to specialise in performing the work he cannot do, in order to free his energy. The more *machines*, the more *people* are needed in the different auxiliary and service occupations. More and more people are needed to build machines; to build always new machines, to work the machines; to help and to cater for the people who work the machines. More and more people are needed for mankind to be able to cope with the immense new projects, new inventions, new enterprises, new possibilities—the new possibilities to make the rose grow in the desert, to make the sea provide us with sweet water, to make the soil give the inexhaustible riches that lie hidden in its depths as in the depths of the sea, idle and wasted.

Small communities make small achievements, but only great populations can achieve the great wonders of civilisation. That, of course, does not mean that a small, militant and adventurous population cannot conquer, rule, exploit, and make bigger populations work for its purposes. Of course it can, and it does often. But the credit for the achievements is still due to the efforts of the bigger populations.

Now, it is wrong to mix up the problems of the present and the immediate future, with the problems of a distant future, when discussing the immediate perils of humanity, on the one side, and the future possibilities on the other side.

Immediate Dangers

Let us start with the immediate dangers, then. The scare of the so-called "population explosion" is one of the wickedest techniques of capitalist society for diverting our attention from the true perils that confront us today thanks to the machinations of monopoly capitalism. The new scare aims at creating new scapegoats and focusing our gaze on some bogus danger.

The possibilities of all the resources of nature being swallowed up by an ever increasing population is today much more remote than it was in the days of Malthus, and is as remote as the possibility that the sun is going to cool down to a stage when it would become completely extinguished. To turn such speculations into practical politics now would be either criminal, or mad, or both.

There is, of course, always a discrepancy between the slow progress of history, and the pressing problems of the individual. To expect every individual to sit and wait with all his private problems for socialism to come and solve those problems would also be foolish and wicked.

Families and individuals who cannot cope with objective circumstances and seek advice in their family planning should, of course, be given help and medical advice on the matter, wherever people live, whenever they need and want such help and advice. No one should have a child against his or her own wish. But if *forced* on people, or even if people should be *scared* into it, this kind of "planning" would not be any different from, nor any better than, Hitler's sterilisation of the Jews. "The Jewish menace" and "the menace of over-population" are not basically different. And the true cause of the scare originates from the same source. Before every war launched by the forces of reaction has come the cry of "over-population".

There were always wars, there were always outbreaks of famine; which came periodically and with devastating regularity. Wars, famine, plagues and pestilence were much more frequent when the human race was but a small fraction of what it is today. That does not mean that war and famine must always be with us any more than all the plagues and epidemics. On the contrary, the time is now ripe for man to stop that vile and horrible state of affairs once and for all. But it means that wars and famine have nothing to do with over-population.

What to do?

What are we to do? And before going any further, let me state here emphatically that contraceptives will not solve the problem.

What are we to do then? First, the immediate thing to do is help the hungry by giving them bread to eat, water to drink, clothes to wear.

Rally with "Oxfam" and all the humanitarian relief organisations to save the suffering people.

Second, fight with the CND and all anti-militarist organisations against war, against the manufacture of arms, against the criminal waste of human work and resources on the manufacture of means of extermination. Arms manufacturing and arms trading is the voracious beast that swallows up the fruits of human toil, and causes famine, poverty, death.

And last, but not least, fight for socialism; fight in deed and in word for true socialism. And do not let yourselves be bamboozled with reactionary theories.

The menace of the direct extermination of the human race, rather than over-population, is the real menace that confronts us today.

Just a few months ago America declared that as there is peace now between India and Pakistan, America intends to withdraw her aid to both of them.

Give Man a Chance

America intends to stop all aid in food and essentials because the shipments of food do not bring in the profits that the shipment of armaments do. And not even the profits that contraceptives bring, as the latter take up much less space than food and are cheaper to produce. Contraceptives, arms,

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coco cola, drugs, are the precious gifts the ships bring to India, and in exchange for those gifts America hopes to get concessions in India which would stifle India's industrial development. An industrial country stops being a source of raw materials and cheap labour, and it stops being a market for foreign ready-made goods. Hence America intends to stifle industrial development in India.

Those are the causes that keep India (one of the richest countries in the world, former British colony and now at the mercy of American monopoly capitalism) in abject poverty. Those are the causes why India is kept from solving her own problems and faces famine, instead of living in luxury and splendour, if given a fair chance and helped to develop her industry.

Through the threat of war and famine India is forced into slavery. But only full independence, industrialisation and socialism can save India, not contraceptives and arms.

There are plenty of open spaces and virgin soil, just give man a chance. Man can build hanging gardens and houses to reach into the clouds. Man can plant trees in the desert and make them bear fruit, but man is in fetters.

To achieve all the wonders of the world requires less strain and effort than to fight other people in the desert. Is it a dream? Maybe. But it is a dream which is easier to realise than the American dream of ruling the world, if we are not bamboozled into accepting bourgeois subterfuges, and if we follow the Marxist ideology, without submitting Marxism (that greatest of all weapons of the working classes), to the hidden and overt, conscious and unconscious enemies of the working classes.

People flock to the cities where there are more people. But, as Tolstoy said, "nobody so much appreciates the beauty of the country as the townsfolk". Just give them a chance, and they would begin to see and love and appreciate the beauty of the countryside, and they would flock back to it. There is enough for everybody, if those who hold power did not say to everybody "get off, it's mine. . . ." Especially when in actual truth it is the working people that worked for all the riches, that surround us, the riches which are now usurped by the few.

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